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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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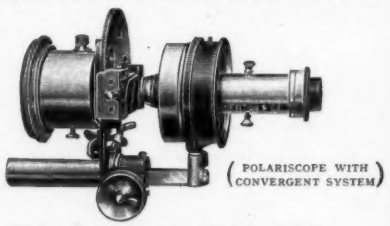

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THURSDAY, OCTOBER 6, 1921.

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The Prevention of Venereal Disease.

THE interest of many readers of NATURE has no doubt been aroused by recent correspondence in the *Times* upon the subject of prevention of venereal disease, together with the trenchant article by its medical correspondent directing attention to the refusal by the Ministry of Health to accede "to the application of some of the greatest medical authorities in the world for leave under Section 2 of the V.D. Act of 1917 for":—

"The preparation and sale by chemists under the supervision and control of the Society for the Prevention of Venereal Disease of the materials for immediate self-disinfection recommended by them,"

And for:—

"The framing and issue by the Society for the Prevention of Venereal Disease of the necessary instruction for the efficient application of those disinfectants, as it is obvious that the provision of disinfectants without instructions as to their application would greatly diminish the efficacy of this method of prevention of venereal disease."

Owing to the very serious immediate and remote results upon the health of the nation of this widespread preventable disease, which has increased in prevalence as a result of the war, it is desirable to consider the facts concerning the measures which the Ministry of Health have adopted or prepared, and compare the same with those in operation in the Commonwealth of Pennsylvania.

The Ministry of Health has established 191 free treatment centres, which cost last year half a million pounds. The taxpayer will naturally ask whether people who incur the risk should not be required to pay for treatment, and it is not surprising, therefore, to find indications of a change of policy of the Ministry, for on page 119 of the recently issued Report of the Chief Medical Officer it is stated:—

"It is extremely desirable that fuller arrangements should be made by the authorities for bringing the general practitioner within their schemes of treatment or education. It cannot be too clearly understood that the best way of dealing with most cases of these diseases is through the skilful private practitioner. For a substantial portion of this problem, the public clinic should be looked upon as a temporary organisation pending the time when the practitioner is ready, available, competent and properly equipped to undertake effective treatment. Certain patients require hospital treatment, but the authority should not needlessly establish institutions, if and when the ordinary channels of medical practice are available and reliable or can be made so."

This pious medical opinion should be compared with the following practical measures which have been adopted and carried out by the Health Commissioner of the Commonwealth of Pennsylvania.

"The Department of Health of the State of Pennsylvania maintains thirty public clinics for the treatment of venereal disease, over which it has entire supervision and for which it assumes all financial responsibility. In these clinics free treatment is given to those patients whose economic condition will not permit treatment either by private physicians, or by clinics charging a fee. Upon entrance to clinics, patients are questioned as to their ability to pay for services. Those able to pay a private physician are referred to outside doctors who are registered with the clinics. If in a position to pay only a small sum they are referred to hospital clinics which charge a nominal fee. Indigent patients are treated in the State Clinics."

It will be observed that discrimination is shown in respect to free treatment. The practitioner registered with the clinic, it may be assumed, is ready and capable of carrying out treatment efficiently, for which he is paid by the infected person.

In our system there are no measures taken to prevent discontinuance of treatment, consequently a large percentage remain infective and are left to spread the disease broadcast. This is manifested by the table of statistics in the Report, which shows that of 176,415 who attended the 183 treatment centres in the year 1919–20, 59,328 did not complete the course of treatment, 15,831

discontinued before final tests regarding cure were completed, and only 21,540 were discharged after completion of treatment and observation.

The health authority of Pennsylvania has foreseen this important matter of discontinuance of treatment, and it has enacted the following regulations :—

"When a patient discontinues treatment before he (or she) is cured or rendered non-infectious, the social service worker follows up the case and sees that the patient returns to the clinic as long as the disease is in the infective state. This is accomplished first by sending him a notice to return for treatment. If this does not effect a return, the clinic makes use of the legal machinery at the disposal of the Department of Health.

"Venereally diseased patients in the infective stage are subject to quarantine, when through neglect of treatment, habits, occupation or failure to protect others, they are menaces to the public health."

In this country there are no legal measures of this nature, and the very large percentage of persons attending the clinics who discontinue treatment and disregard the warning they receive, or should receive, that they are still infective and a menace to society, shows that some further measures of a disciplinary nature are necessary to make these clinics efficient.

The following passage from the Report of the Ministry of Health indicates that a number of the clinics are not efficient.

"I am bound to advise that if the work of these clinics is not properly done—if it is casual, superficial or perfunctory—they should be disapproved by the Ministry. It is better to have only a few clinics well organised and scientifically controlled than a large number which are not thus administered."

The small percentage of persons attending the clinics who were discharged as certainly non-infectious, and the large percentage who do not complete a cure and are still infective, is explained if the service at a number of these clinics is casual, superficial, and perfunctory.

We entirely agree with the Report in the statement :—

"Whilst the V.D. clinic has proved in practice the centre of the treatment, it is but part of the national scheme for dealing with these diseases. The other and more important part concerns prevention."

But how does the Ministry propose to carry it out? By ablution treatment at the clinics. But the Report shows dissatisfaction with the service at a number of the clinics. Is it likely that ablution and irrigation will be efficiently carried out where the treatment is liable to be "casual, superficial and perfunctory"?

The Report gives the following reasons against the advocacy of the practice of self-disinfection :—

"The Ministry believe that thorough cleaning and skilful disinfection of the body immediately after risk of infection has been incurred tend substantially to reduce the likelihood of disease, but the Ministry are not prepared to recommend a general practice of self-disinfection apart from skilled advice and supervision. It is believed that except under skilled control attempts at self-disinfection are likely (1) to be ineffective; (2) to create a false security and thus an increase in promiscuity; and (3) to lead to postponement of treatment which thus becomes more difficult and uncertain. It is impracticable to train the general public in effective *self*-disinfection by means of leaflets of instruction. What is required in all such cases is not general directions for self-manipulation but prompt and skilled advice."

We may ask, is this fear of failure the sole reason? Are there not, in a great measure, the same influences at work that interfered with prophylaxis by self-disinfection being carried out efficiently in the services during the war, viz. the National Council and its supporters, which set out to combat venereal disease and still finds it increasing in spite of its moral propaganda and curative treatment centres.

We have no desire to dispute the fact that "skilled disinfection" as carried out by the American Army was efficient, but let us see what the Commissioner of Health of Pennsylvania says about skilled disinfection in civil life :—

"Immediate treatment (venereal prophylaxis) for those exposed to disease has been approved by the Pennsylvania State Department of Health. Prophylaxis as used in the army by means of stations is impracticable in civilian life. Tubes containing material for self-disinfection are given the Department's approval, when after tests they meet requirements. The material usually employed is after the formula of Metchnikoff. The tubes are on sale in drug stores."

Any unprejudiced thinking person must see many grave defects in trusting to disinfection stations to control venereal diseases effectively, even if municipal authorities change their mind and sanction the increased expenditure which such stations would entail.

It is certain that a large proportion of civilians who expose themselves to infection could not, or would not, seek skilled disinfection even if the locality of the stations were favourable and even if its efficiency were all that could be desired.

The delay in a majority of cases would prevent skilled disinfection from being effective. From an economic and efficiency point of view, therefore, we are of opinion that the Health Department of Pennsylvania has wisely adopted "self-disinfection" as one means of controlling venereal disease, and it is to be regretted that the offer of the Society for Prevention of Venereal Disease, backed by the names of so many distinguished physicians and surgeons, should have met with a curt refusal from the Ministry of Health.

L'Espace dans la Chimie.

The Principles of the Phase Theory. Heterogeneous Equilibria between Salts and their Aqueous Solutions. By Dr. Douglas A. Clibbens. Pp. xx+382. (London: Macmillan and Co., Ltd., 1920.) 25*s.* net.

AMONG the gifts which the older science of physical chemistry gave to chemists, undoubtedly the graphical treatment of heterogeneous equilibria, founded on the phase law of Gibbs, will always occupy a prominent position. Begun and extensively developed by Roozeboom and van't Hoff, this most valuable and elegant branch of science has been carried on in a masterly fashion by Schreinemakers. Special and most important developments of it are due also to Cohen and to Smits.

So great and conspicuous is the work of these five Dutch physical chemists that we may fairly call the science of heterogeneous equilibria a Dutch science. This statement is all the more justified when we recollect that the theoretical and experimental physics of the simpler systems is very largely due to the work of the Dutch physicists, van der Waals, Kamerlingh Onnes, Kuenen, Keesom, and Crommelin, etc. The Dutch nation is indeed to be congratulated on the splendid work which their men of science have done in this field, and it is pleasant to observe that Dr. Clibbens has dedicated the present volume to Prof. Schreinemakers.

The great power of the graphical treatment of heterogeneous equilibria lies in its ignoration of co-ordinates. In order to apply it we do not require to know the co-ordinates which define the *inner mechanism* of equilibrium in any phase. It is not even necessary that the constituents of any phase should be in perfect inner equilibrium. All that is necessary is that the various phases should be in equilibrium with each other—that is to say, that the chemical potential of each component should have the same value in all the phases, and that the same thing should hold good for temperature and hydrostatic pressure (at least in all ordinary applications).

We may say that what cartography is to the geographer and land traveller, practical astronomy to the navigator, and engineering drawing and graphics to the engineer, the graphics of heterogeneous equilibria is to the chemist. Without the maps made by other chemists and the knowledge of how to do his own surveying and map-making, the chemist of to-day will do much useless wandering, and probably lose his way entirely.

It is a strange thing that, even after the lapse of some thirty years, so little real attention is devoted to the science of heterogeneous equilibria in our instructional courses in chemistry at the universities and higher technical schools. The only people who take it seriously are the metallurgists. From their closer connection with the outside world they know that it spells business, and very good business too; but in reality it is just as important for the chemist. Whatever chemical work he does in the world, he will have at some stage or other to separate heterogeneous mixtures into pure constituents by crystallisation, distillation, sublimation, and phase-distribution. In designing chemical processes and plant he will be asked by the engineer to specify what phases will be present and in what amounts, under specified conditions of pressure, temperature, and concentrations of initial materials. The engineer, accustomed to quantitative data and calculations, will want the answer in figures. He does not want any of the "tricky" work of Mary Ann making the Sunday rice pudding, although that is just what he gets at present from the majority of chemists—even highly trained ones, who can tell you what the inside of an atom looks like, or what the camphor molecule would be like if it would keep quiet and stand at attention. These learned gentlemen resemble an engineer who has "jumped" all his engineering drawing and graphical statics, and taken to the study of relativity. Even the members of the "Argonaut" expedition had some sort of map in their great quest.

No man can really claim to be a well-trained chemist nowadays unless he can handle the theory and practice of a four-component system as he would an ABC railway-guide. Alas, how many of us can say that? We mean well, but when it comes to the test we fall back on the methods of Mary Ann. Every university chemical institute should have a special laboratory and a special drawing-office for the study of heterogeneous equilibria. The reason for this is

not pride, or romance, or vainglory, but simply the sober necessities of business. And what young man is there with soul so base that the beautiful geometry of this work would not appeal to him and be a more than sufficient compensation for the tribulations arising from the analytical work? The mind of the chemist, unlike that of his future colleague the engineer, really dwells in a point. He lacks the sense of space and the power of thinking spatially, or, rather, most of his work tends to produce that lack. What better corrective could there be than the study of a four-component system? If the chemist is going to rule the world—as he hopes and as he ought—he must cease to be a point-man. He must become an understander and controller of space. If not, well, then the engineer will occupy the space, and the poor old chemist will continue to sit at his point and wonder what is wrong—as he has done these many years.

In the preface to his book Dr. Clibbens gratefully and gracefully expresses his indebtedness to Capt. Francis Arthur Freeth, under whom he studied the science of phase-equilibria in the research department of Messrs. Brunner, Mond and Co. There is also an introduction by Capt. Freeth. No doubt Dr. Clibbens would be the first person to admit that this book is really a product of the Brunner, Mond Research Laboratory, and therefore of its director, Capt. Freeth. During the past fourteen years the science of heterogeneous equilibria and its practical application have reached a degree of development by Capt. Freeth, which is unequalled in any part of the world. Known to very few before the war, this fact became revealed to many by the magnificent work which Messrs. Brunner, Mond, and Co. did in connection with the manufacture of ammonium nitrate by three different methods. It is an open secret now that the work which this company did in this field alone saved the cause of the Allies at a critical stage. The final method which they employed—namely, the direct production of ammonium nitrate from sodium nitrate and ammonium sulphate, was a splendid triumph of scientific industry. Success was due to the intimate co-operation of scientifically trained directors and engineers with the Chemical Research Department; but the former would be the first to admit that, without the exact data yielded by Capt. Freeth's series of phase-isotherms, no successful process—indeed no process at all—could have resulted.

There have been many books dealing with heterogeneous equilibria, from the pioneer text-books of Bancroft and van't Hoff to those of Findlay and Kremann. Foremost amongst the more fundamental treatises stands, of course, the great work of Roozeboom, ably continued by Schreinemakers, with which may be classed the "Gesättigte Lösungen" of Jänecke, and the "Ozeanische Salzablagerungen" of van't Hoff. The present work of Dr. Clibbens is the first book in English to attack seriously the real geometry of the subject. He carries us from the delightful simplicity of binary systems right up to the real thing—quaternary and quinary systems. It is evident that Dr. Clibbens can think in space, and expects his readers to do the same. That is certainly necessary; but if one might cavil at all it would be to suggest that the author follows Schreinemakers a little too closely in his method. In leading the novice up the steps of Parnassus Dr. Clibbens has no mercy in his geometrical logic. As the mind of the ordinary man—and especially that of the chemist—gets abstract only by gentle degrees, it would have been well if the author had paused, at each stage in his heavenward journey, to work out *thoroughly*, both geometrically and arithmetically, a typical concrete case; and in his admiration for triangular co-ordinates he fails to do justice to the less general but very useful system of open rectangular co-ordinates.

But these are small matters in comparison with the great value and excellence of the book. It is one which every chemist must study and digest, and it is certain that it will have a great and salutary effect on the rising generation of English-reading chemists. Messrs. Brunner, Mond, and Co. are to be heartily congratulated on the important contribution which their research department has made to the advance of chemical science.

To the young chemist of the present day one may say these words. Study the mighty atom and its still mightier inside. Study also the organic molecule with its trailing field of glory and its vibration-frequencies; but if you want to be a man amongst men in the great world that toils with large masses do not "jump" the geometry of heterogeneous equilibria. It is the key that unlocks many doors.

Practical Anti-tuberculosis Work.

Industrial Colonies and Village Settlements for the Consumptive. By Sir German Woodhead and P. C. Varrier-Jones. With preface by Sir Clifford Allbutt. Pp. xi+151. (Cambridge: At the University Press, 1920.) 10*s.* 6*d.* net.

NO one wishing to be prepared adequately for practical anti-tuberculosis work can afford to neglect this little volume. Its authors

are well known for their protracted studies of the subject, which are embodied in the present volume. We could have wished that the different essays and addresses, which form the larger part of the book, had been rewritten in more regular sequence, for this would have saved the reader's time and conduced to more impressive exposition. However, the whole of the work deserves study, and there is something to be said in favour of repetition of the same theme from a new angle.

There cannot be said to be anything exactly new in the book, except in the important particular that what others had discussed and regarded as desirable, in the Cambridgeshire colony described in this book, has been shown to be practicable and competent to bring improved results in the treatment of tuberculosis. There is, with the possible exception of syphilis, no disease which better illustrates than tuberculosis the synthesis and inseparability of treatment and prevention. Each patient treated successfully is thereby deprived of the power of infecting others; and each patient who, apart from cure, is taught during treatment the hygiene of his disease, and made to believe practically that his own recovery, as well as the safety of others, depends on his adopting hygienic precautions in coughing and expectorating, is an added influence towards the extermination of tuberculosis. There is appositeness in the illustration, that just as Sir Arthur Pearson said to his blind pupils: "The first thing you have to do is to learn to be blind," so the consumptive must "learn to be a consumptive," and to play the game both for himself and for those about him. It is because so many sanatoria have failed to impress this lesson, and to make it part of the life of the consumptive, that the loafing habit has been encouraged, and even partial return to industrial efficiency has been exceptional.

Others before the present authors have advocated farm colonies, industrial colonies, after-care associations, and allied agencies, and much good work has been done. At the Bourn and Papworth colonies a demonstration has been made of the practicability of dealing with all classes of consumptives at one institution. This practical application of the *vue toute ensemble* is especially valuable, particularly so when the views adopted by the authors of this book on the pathology of tuberculosis and the essential measures for its prevention are those which offer the greatest prospect of success. We all know that the infection of tuberculosis cannot be entirely avoided, but that practical danger arises only when the dosage of infection surpasses the powers of resistance. Hence minimisation of infection and measures for improving general health must go hand in hand.

The authors speak with authority on the importance of preventing the spread of massive infection, of "turning off the tap before we begin to empty the trough." Again: "Small doses of tuberculous virus *may* be harmless, large doses *must* be guarded against." They quote Sir Arthur Newsholme's conclusion that the admission of a large proportion of advanced consumptives to infirmaries has lessened the spread of disease, and add that this "points the way to the next step—the segregation of these middle cases in colonies, where, with the best chance possible of recovery, they also cease to be a source of infection to others." It is on this principle that the Cambridgeshire Tuberculosis Colony is based. It is an all-round scheme, covering every grade of tuberculosis: "We are satisfied that it is impossible to keep tuberculous patients in watertight compartments," and therefore early, middle, and advanced cases are treated in separate divisions of the same institution, which comprises the hospital at one end of the scale, the village settlement at the other, with intermediate rest houses for febrile patients, open-air shelters, hostels, and workshops. Here the patient has a reasonable hope of being made, not into a valetudinarian, but into a useful and productive member of society, who, although he may remain a consumptive, can even enjoy his life.

This is a hopeful view of the problem. Such institutions have a definite and increasing possibility of utility. It would, of course, be a mistake to assume that colonies of this kind cover the whole problem. They could not do so unless they were adopted on a gigantic scale; for various reasons a large number of chronic, but incurable, consumptives will need to be dealt with in urban homes, in hospitals, and in their own homes. A large proportion of partially recovered patients will recover only 75, 50, or 25 per cent. of their full working capacity, and there is need for the further organisation, on a scale commensurate with the magnitude of the problem, of provision for them of the three desiderata which are quoted by the authors of this book from an official report in the following words: "If the patient is to have the best possible prospect of recovery, and if his family are to be safeguarded against infection, in many cases he will need (*a*) improved housing; (*b*) occupation adapted to his physical capacity, etc.; (*c*) the family income will need to be supplemented. These requirements

for many patients have not hitherto been met."

The last section of the volume is an admirable summary of the subject. We hope it will be read by, and give fresh heart to, all engaged in national tuberculosis work. We wish it could be brought home also to the hearts and minds of central and local governing bodies, who, unfortunately, at the present time, are engaged in whittling down essential public health activities, which is anything but economy of the welfare of the Commonwealth, on which efficiency depends.

Physics and Chemistry of Bioluminescence.

The Nature of Animal Light. By Prof. E. N. Harvey. (Monographs on Experimental Biology.) Pp. x+182. (Philadelphia and London: J. B. Lippincott Co., 1920.) 10*s.* 6*d.* net.

BIOLUMINESCENCE—that is, the production of light by animals and plants—is a phenomenon which has excited wonder in the layman and given rise to many investigations on the part of the man of science. Since the results of these investigations, many of them of a purely qualitative nature, are widely scattered in the literature of various countries and not always readily accessible, the author has rendered a distinct service in collating the various facts and presenting them to the scientific public as a connected whole. The biological aspect is referred to but briefly, in a chapter on the structure of the luminous organs, the main portion of the book dealing with the physical characteristics of animal light and the chemical processes underlying its production. The study of bioluminescence is another instance of the application of physics and chemistry to biological and physiological problems; the author's treatment is clear and, so far as the present state of our knowledge is concerned, convincing; it shows, moreover, that he has full command of the cognate sciences.

After providing, in the first two chapters, an account of the physical phenomena of luminescence and incandescence, in which, especially, the various kinds of luminescence are adequately discussed, a detailed description is given of the results obtained in the physical investigations of the nature of animal light. It is in such physical investigations that most progress of a definite nature seems to have been made. Exact quantitative measurements have established that the light emitted is in no way different from ordinary light, except in intensity and spectral extent; it is all visible light, containing no infra-red or ultra-violet radiations or rays which are capable of penetrating opaque objects. Like ordinary light, it will cause fluorescence and phosphorescence of substances, affect a photographic plate, cause marked heliotropism of seedlings, and stimulate the formation of chlorophyll.

The efficiency (=visible radiation × visual sensibility÷total radiation) of the firefly as an illuminant seems to be of the order of 96 per cent.—that is, immeasurably superior to any artificial source of light. The light, however, supposing it could be put to use, would not be suitable for artificial illumination, since all objects would appear a nearly uniform green hue. Although the light of the firefly is the most efficient known, so far as amount of light for expenditure of energy is concerned, it has been produced at the inevitable expense of range of colour.

The last three chapters deal with the chemistry of light production and the dynamics of luminescence. As is only to be expected from the nature of the case, the chemistry of bioluminescence has not yet been placed on a basis as satisfactory as the physics thereof; the evidence, as yet, is mainly of a qualitative nature. It seems to be established that, in at least three groups of animals, luminescence is due to the interaction of two substances, luciferin and luciferase, in the presence of water and oxygen. Luciferase is a protein, all its properties agreeing with those of the albumins, and may be regarded as an enzyme; luciferin has many properties in common with the proteoses and peptones, but its chemical nature still remains to be decided. The stage to which our knowledge of the dynamics of animal luminescence has advanced may be indicated by the fact that the author only commits himself to the statement that "perhaps the reaction takes place in two stages," a compound luciferin–luciferase being first formed and then undergoing oxidation.

A valuable bibliography is given at the end of the book, which is printed in clear type and well supplied with illustrations and diagrams.

T. S. P.

Our Bookshelf.

The Arithmetic of the Decimal System. By Dr. J. Cusack. Pp. xvi+492. (With answers.) (London: Macmillan and Co., Ltd., 1920.) 6*s.*

DR. CUSACK is a firm believer in the decimal system, and there can be no doubt that he speaks with some authority, in view of the great experience he has enjoyed of teaching arithmetic and other branches of a business training to all classes of pupils. Many have argued theoretically about the educational and commercial advantages of a

decimal system, as against the complicated notations now in use in this country, and some have worked out decimal systems which they considered suitable for introduction by Act of Parliament. Dr. Cusack has gone a step further by producing a text-book of arithmetic in which the calculations are all in terms of the decimal notation, and the various quantities dealt with, like length, area, volume, weight, and money, are all decimalised.

The author does not desire to introduce the *metric* system. This is merely one form of decimal system, and Dr. Cusack considers that we in this country are so much accustomed to the use of the yard, the hundredweight, the gallon, the pound sterling, etc., that it is necessary to retain these units in any decimal system we employ. The effect of the acceptance of this idea would therefore be merely the abolition of the vulgar fraction in business and other calculations; the difference between the English and the Continental units would still remain. This is not the place for a discussion of the problem, but it must be pointed out that a considerable fraction of the advantages derivable from such a radical change of our English system of units would be lost if we refused to fall in with the Continental metre, gramme, and litre. As regards money units, the matter is entirely different—international exchanges have such huge relative time-gradients that it is idle to attempt any international equalisation of the currency.

Dr. Cusack's book is excellently written and produced. It is really a piece of propaganda literature, and as such it should have more effect than any number of Parliamentary speeches and Chamber of Commerce resolutions in educating public opinion in the direction of accepting a long-overdue reform of our system of units.

S. BRODETSKY.

Annales de l'Observatoire astronomique de Tokyo. Tome 5, 4e fascicule. Studies on Astronomical Time-Keepers and Time-Preserving Systems. By Kiyofusa Sôtome. Pp. ii + 59. (Tokyo: Imperial University, 1921.)

THE problem of the determination and distribution of accurate time has been advanced considerably in recent years by the use of the moving wire in observing transits, and the introduction of wireless time-signals. Hence the analysis of the behaviour of high-class time-keepers under various conditions, which is dealt with in this memoir, is likely to be of general utility. Mr. Sôtome notes that chronometers are essential in Japanese observatories as a supplement to pendulum clocks, on account of the prevalence of earthquake shocks, which produce abrupt changes on the error and rate of a clock, but have no sensible effect on a chronometer. It is shown that the chronometer rates are sensitive to changes of atmospheric pressure and humidity, so that an air-tight case should be used. Most of the chronometers showed perceptible change of rate according to the interval that had elapsed since winding; this change was diminished by using a falling weight instead of a spring as motive power, a method that is practicable in an observatory, but not at sea.

The section on pendulum clocks deals not only with those at Tokyo, but also with the records of the standard clocks of several European observatories. There is a curious general tendency to acceleration of rate, which may be due to accumulation of dust, rust, etc., on the rod and bob. An examination is made of the properties of different metals that are used as pendulum rods; it is found that invar is subject to gradual elongation and irreversible thermal expansion; quartz or tungsten are suggested as suitable. The importance of an air-tight chamber, with constant pressure and temperature, is emphasised.

Finally, the memoir deals with the determination of true time, which involves the distribution of error between the transit observation and the timepiece. It is suggested that abnormalities in the former may sometimes be due to lateral refraction, arising from unsymmetrical temperature distribution. The ratio of probable errors of the observed transit and the assumed clock rate having been found by experience at each observatory, formulæ are given for obtaining a weighted mean clock error.

A. C. D. CROMMELIN.

String Figures. By W. W. Rouse Ball. Second edition. Pp. 69. (Cambridge: W. Heffer and Sons, Ltd., 1921.) 2*s.* 6*d.* net.

THIS book is a second and enlarged edition, of which we have already noticed the first issue (NATURE, vol. 106, p. 640). The subject is comparatively new, though one variety, the cat's cradle, has a literary pedigree from the eighteenth century, and the boys at Christ's Hospital used to play it in the time of Charles Lamb, as related by that charming writer in his essay on the famous foundation; but the discovery of the more interesting forms dates from the Cambridge expedition to Torres Straits in 1898 under the leadership of Drs. Haddon and Rivers. Since then many interesting figures have been recorded, notably in America, by Mrs. Jayne.

The invention is certainly due to the lower culture, and the distribution of the figures is very interesting. That known as "Lightning" comes from the Navaho Indians of Arizona; the now almost extinct Apaches passed on the "Tent Flap" to the Mexican Indians; "Man Climbing a Tree" comes from the Queensland blacks; the "Batoka Gorge" was accidentally discovered by someone who showed some other figures to the native police escort at the Victoria Falls. In fact, as Mr. Ball tells us, no self-respecting anthropologist ought to go about without a piece of string in his pocket. As anyone can now learn a fascinating game under his careful guidance, it may be hoped that field anthropologists will soon tell us more about its various methods and its origin.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Resting-place of Robert Boyle.

SOME months ago, having become very much interested in the life and work of the famous English philosopher, the Hon. Robert Boyle, and animated to a certain extent by the spirit of the pilgrim, I thought I would go and look at his last resting-place. According to Thomas Birch, who brought out in five folio volumes the works of Boyle with a "Life" in the year 1744, the philosopher died on December 30, 1691, seven days after his sister Katherine, Lady Ranelagh, with whom he had been keeping house in Pall Mall for more than twenty years. Brother and sister were buried in the chancel of St. Martin's-in-the-Fields.

On reaching the church I learned that the old church in which they had been laid was pulled down in 1721 and replaced by the present edifice. On inquiry of the rector he referred me to his churchwarden, Mr. John MacMaster, from whom and from his interesting book on the church the following facts are derived:—

The foundation-stone of the new church was laid by the Bishop of Salisbury on March 19, 1721. James Gibbs, a pupil of Wren's, was the architect. "As the bodies buried in the church and part of the churchyard would be disturbed during the rebuilding, an advertisement was inserted in the newspapers notifying that the bodies and monuments of any of those buried could be taken away for reinterment by relatives on application to the Vicar, Wardens, and Commissioners. Several bodies and monuments were removed." It appears, however, that applications for permission to set up family monuments in the same position in the new church as in the old were not granted, and those monuments from the old church which were not taken away by relatives were stored under the tabernacle or, in some cases, set up in the vaults and crypt of the present church. It is on record that "Robert Boyle, the gifted son of the Earl of Burlington," was among those buried in the church, but no systematic account was kept of the disposal of the remains in the old church, and there is no monument bearing the name of Boyle in the crypt at the present day.

As it seemed possible that there might be some tradition in the family of action taken by them in 1721 to preserve the remains of the philosopher, I wrote to the present Earl of Cork and Orrery, but could get no information. Later, Lady Grace Baring (*née* Boyle) informed me that after looking into books of family records in her possession no clue could be found to the mystery of Robert Boyle.

It is remarkable that Birch's account of the funeral and burial should have been published without comment or correction in 1744, or more than twenty years after the destruction of the old church. No modern biographer seems to have inquired further into the matter, and it seems probable that the last resting-place of the "Father of Chemistry" will remain unknown to the end of time.

WILLIAM A. TILDEN.

September.

Biological Terminology.

DR. BATHER (NATURE, August 18, p. 778) wishes me to explain my glaring truism, "Variation is the sole cause of non-inheritance: apart from variations, like exactly begets like when parent and child develop under like conditions" [of nurture]. But does it need explaining? As he says, and as I have insisted, variation *is* non-inheritance, and for that reason the truism is glaring. The words "the sole cause of" are really redundant, and were introduced merely to emphasise the fact that there is no other cause. My justification for framing the truism lies in the fact that that truth is more honoured in breach than in observance in biological discussions. I have already expressed myself much in the following terms, but some repetition seems necessary. Every character is a product of antecedent *and* exciting cause, of nature *and* nurture, of potentiality *and* stimulus, of power to develop *and* opportunity to develop. Since the multicellular individual is derived from a germ, he can inherit only through it. In the germ are none of the characters subsequently developed in the soma, but only powers to develop them. Therefore, strictly speaking, he inherits nothing but these powers, the sum of which is his nature, while the sum of the influences which cause change (or arrest it) is his nurture. By a colloquialism, which is pardonable since it confuses no one, we speak of a child inheriting his parent's eyes, or hair, and so on. If a child in response to similar nurture produces hair like his parent's, he has not varied in this respect; he has inherited; he is like his parent both by nature and through nurture. If he develops different hair in response to similar nurture, he has varied; to that extent he has not inherited. If owing merely to different nurture (*e.g.* injury) he produces different hair, or even none at all, he has *inherited*, but not *reproduced*.

Inheritance is altogether an affair of nature; reproduction implies the added element of nurture. Reproduction is proof of inheritance; but non-reproduction is not proof of non-inheritance. There is, indeed, massive evidence of inheritance without reproduction—*e.g.* in latent ancestral traits, male characters in the summer generation of aphides, and the recessive in the impure dominant. If for "hair" we substitute in the foregoing *any* of the characters which biologists call "acquired," and use our words with the same meanings, then all I have said remains exactly true. For example, if a parent and child receive similar injuries and develop similar scars, then the child *inherits* the scar. He would really have inherited even if he had not received the injury and developed the scar. But biologists no not give their words with the same meanings. If a child produces an "acquired character" in the same way as the parent did (if he is like the parent both by nature and through nurture), they say he has not inherited, but acquired, that trait afresh—as if every trait were not acquired afresh every time. They assume that he would "inherit" only if he reproduced the same trait in response to some different nurture, only if he did not inherit, only if he were unlike the parent both by nature and through nurture. The word "inherit" now means "vary." Now comes my point. The truism is founded on the assumption that all characters that can possibly be developed are, *necessarily*, and in exactly the same sense, equally innate, acquired, germinal, somatic, and inheritable. Nearly all biological discussions (*e.g.* the Neo-Lamarckian and Neo-Darwinian) are based on contrary assumptions, and imply, therefore, the denial of the truism. If it were accepted *and borne in mind*, most of the labours and disputes

which have occupied biologists would automatically end, and the way be cleared for further advance. Is this the explanation that Dr. Bather desires?

Can Dr. Bather tell us in terms of utility why, when all characters are equally innate, acquired, and inheritable, biologists should distinguish them from one another by these terms? I am sure he will find the task impossible. Fortunately, the historical explanation is clear. Formerly it was universally believed (and still is popularly) that the soma of the child was derived, by means of physiological units, gemmules, or what not, from that of the parent—the child's head from the parent's head, and so on. Granting that assumption, this, the child's heritage, was innate. But it could be altered, as by injury and use, and these alterations were acquired. If the soma of the child took origin in that of the parent, it was reasonable to believe that characters acquired by the parent could be transmitted in some degree to the child in whom they would be innate. Hence the Lamarckian hypothesis. Obviously, with this conception of heredity, the application of the distinguishing terms "innate," "acquired," and "inheritable" was intelligible and correct. Characters actually were innate *or* acquired, inheritable *or* non-inheritable. Nature and nurture were warring forces, and attempts to estimate their relative strength were reasonable. But no clear distinction could be drawn, and, in fact, none was drawn, between variations and modifications, which were all called variations. The truism was not true, for what we now recognise as modifications altered the heritage, and like did not produce like under like conditions of nurture alone.

After the discovery of the cellular structure of the body the belief grew that the heritage travelled solely down the germ-tract. If that were true, only potentialities to develop in this or that way were transmissible; all characters were equally products of nature and nurture; the terms "innate," "acquired," and "inheritable" became inapplicable to characters as distinguishing terms; the physiological classification of characters as responses to various stimuli became necessary and clear, as did also the distinction between variations and modifications; nature and nurture were not warring, but co-operating, forces; the Lamarckian discussion became absurd, for valid reasoning cannot be founded on non-existent differences; the truism became true, and, since it covered almost the whole area under discussion, there ensued a vast simplification of study. One now thought of development in terms of nurture, and evolution and heredity in terms of the potentialities of the germ-plasm, which was conceived as changing through the ages, by the accumulation of variations in it, in such ways that some of the old potentialities were eliminated or altered and some new ones evolved. For example, one conceived man as differing from the oak because his nature, and therefore his nurture, was different. One ceased to regard him as a being compounded of innate and acquired characters.

Biologists failed to perceive fully the necessary implications of their own discoveries. "Men believe that their reason rules over words; but it is also the case that words react, and in their turn also use their influence on the intellect." The words "innate," "acquired," and "inherit," sanctified in usage by tradition, exercised a fatal influence. Instead of perceiving that all characters are equally innate, acquired, and inheritable, biologists proceeded to fortify the error by coining new synonyms ("germinal," "somatic," "blastogenic," and the like) and to discuss the "transmission of acquired characters," "the intensity of inheritance," and so on. In other words, the old notion that the parts of the child are derived from those of the parent was wonderfully combined, by means of a misuse of language, with the new and quite incompatible belief that the heritage travels down the germ-tract. When a supposition is true or untrue it may be proved or disproved. When it is nonsensical it can be neither proved nor disproved. Crucial testing is then impossible; discussion leads merely to more nonsense. At once the word "inherit" acquired, quite unnoticed, two contrary meanings, and, besides, was often used as synonymous with "reproduce." Endless controversy arose; sects developed; holy ways of gathering (*i.e.* restricting) evidence were acclaimed; the habit of calmly examining all the evidence by means of crucial testing fell very largely into abeyance. Thus did biology achieve the scientific status of theology and politics. Hence the present chaos. Hence the fact that, though biologists believe that all characters that develop in response to use are "acquired," they, following tradition, limit the term to some only of the characters that so develop. For example, while they term the muscles of the blacksmith "acquired," they consider those of the child and the ordinary man, which grow in response to similar nurture, "innate." Hence the failure to observe the magnitude of use-developments in the higher animals, and, therefore, to perceive what is for human beings the most important phase of all evolution, that of the power of so developing. Hence the fact that I, a mere outsider, neither zoologist nor botanist, am able to write so impudently without fear of being eaten like a shrimp, as would have happened had I assailed physics, chemistry, mathematics, astronomy, or descriptive zoology or botany.

Biologists may declare that their terms have technical meanings. But no such meanings which accord with usage can be thought of. The evidence in literature is plain that every writer has really believed that some characters are more innate, acquired, and inheritable than others. Witness the synonyms. Again, biologists may declare that when they discuss Lamarckian "inheritance" they merely consider whether these so-called acquirements so alter the germ-plasm (cause it to vary) that a character, which evolution fitted ancestors to develop in response to use or injury, tends to be developed by descendants in some other way—*e.g.* in response to a hormone. But why not use plain and correct language? Why designate characters which are not especially innate, acquired, and inheritable by those terms? Why say "inherit" when exactly the opposite (vary, non-inherit) is meant? Why suppose that characters which develop in response to use or injury (and only some of these) have this amazing property of causing such wonderful germinal alterations? Why not speculate as to whether the development in ancestors of ordinary muscles in response to use tends so to change the germ-plasm that ordinary muscles can be developed in descendants in response to other influences—*e.g.* hormones? Why not question whether the development of hair and teeth in ancestors in response to hormones tends to cause their development in descendants in response to other influences—*e.g.* use or injury? Use, injury, hormones, and the rest of what we call nurture are all influences to which evolution has made the individuals of the different races responsive; why, then, select only two of them as causes of "acquirements" in progenitors and of "innate" characters in descendants? Why ignore the evidence furnished by the evolution of the higher animals, which demonstrates that, so far from "innate" characters replacing in decendants characters acquired by ancestors, the contrary has happened on a vast scale; for, unlike low animals, the higher types (in proportion as they are

high in the scale) are born helpless, and must develop mentally and physically in response to use before they can reach maturity and power of maintaining independent existence.

Dr. Bather writes with an air of surprise, "Actually we are now talking of biological method." But have we talked of anything else? What other is the insistence on precision of language and the necessity for crucial testing, and the discussion about the nature of evidence and proof? He continues, "My own difficulty has been to devise a question that should be universally accepted as crucial, or, having devised one, to elicit the relevant facts." He indicates the trouble exactly. Many biologists—among whom I am sure must be Dr. Bather himself—have tested their suppositions thoroughly and established them completely, and yet have had them rejected on irrelevant grounds by large sections of their fellows who have unlike ideas as to what constitutes evidence and what proof—Darwin with his theory of natural selection, for example. Some years ago the late Prof. William James, much amused, furnished me with a case in point. He had happened on an article which seemed to him, as it afterwards did to me, good and conclusive. This he submitted to a biological colleague, who, while disputing not a fact (the facts were indisputable) or an inference (I think the inferences were incontrovertible), quite simply declared that he hoped they had done with that sort of thing for ever. It seems he was a devotee of one of the exact and modern methods.

As to the "difficulty . . . to elicit the relevant facts," I, of course, know nothing about Dr. Bather's special troubles; but I do know that biologists in general have always extraordinarily restricted the area in which they have sought their facts, and that, in the search for exactitude and modernity, they have recently restricted it still further. Of course, other things being equal, "biologists who can experiment with their material are certainly in a far better position to perform both these operations than one who can only observe portions of extinct animals." But that is not the point in dispute. Many sciences deal with organisms that are not extinct; and while experiment may add, and, indeed, has greatly added, to our knowledge, it can do no more; for, after all, it is only one out of several ways of collecting evidence. Dr. Bather says: "Either the glaring truism is an identical proposition or it is a statement actually disputed." I believe he is not quite correct. The statement that "variation is the sole cause of non-inheritance" is, in effect, identical with the statement that, "apart from variations, like exactly begets like when parent and offspring develop under like conditions," *and* it is actually disputed. Moreover, the truism is practically identical with the statement that, "apart from variations, offspring tend to recapitulate the parental development." It is true that biologists are divided on this point—as they are divided on almost everything else—but only, I think, because they use the words "inherit" and "reproduce" as synonymous. I hope to deal with this matter shortly.

I assure Dr. Kidd (NATURE, September 1, p. 11) that there is no "catch" in this correspondence. I have used the plainest and simplest language I can think of, and have pleaded only for the use of ordinary scientific methods, including plain and precise language. I am too ignorant to reason about the hair-patterns of the modern horse; but of this I am sure, that if the collar altered the hair-pattern of the ancestral domestic horse, and if the modern colt reproduces this alteration without experience of the collar, then we have here not inheritance, but variation of a very remarkable and unusual sort. In that case the modern horse is like his domestic ancestor neither by nature nor by nurture. He is like only in very superficial seeming. If Dr. Kidd will not accept the blacksmith's arm as a good illustration, why not reason from that of the ordinary man, which also, as I say, develops in response to functional activity, and has so developed not for twenty, but for twenty thousands of generations.

G. ARCHDALL REID.

Southsea, September 6.

The Green Colouring of Surf on the Horizon.

ON December 16, 1920, at 5h. 30m. p.m. Central Java time, while the steamer *van Noort* was passing by the small island of Pisang, north of Kroë, on the western coast of Sumatra, at a distance of about 3 km., I noticed that the breakers on the shore were not white, but green. Observing the phenomenon with a binocular it was possible to see more details. The low breakers especially showed the green colour. Breakers rising higher became white, the lower right and left corners, however, remaining green. As the breaker ran forward along the shore a green corner preceded, and sometimes the separate crests seemed to be coloured. Along the shore of Sumatra, at a distance of 7 km., no particular colours could be observed. From the upper decks of the steamer the colour could be seen, but it was less intense.

The weather was calm, the sky partly clouded, and the sea grey. The horizon was strongly dipped; I saw a sharp horizon before the isle, the surf seeming to rise above this horizon. By no means could a continuous surface of the sea be seen between the ship and the island. The phenomenon disappeared at 6h. 10m. p.m., when the yellow shore-line of the isle had become invisible below this apparent horizon.

My object in directing the attention of readers of NATURE to this phenomenon is to learn whether the green colouring of surf has ever been observed before. I have been unable to find any description of it, and shall be very glad to learn whether the phenomenon has been seen and recorded by others.

As to the explanation, I believe the cause to be the same as that of the "green flash," as the phenomena agree remarkably in some respects.

Observations of the green flash have been published in NATURE (vols. 93, 94, and 95 of 1914–15). Mr. C. T. Whitmell writes:—"Under favourable conditions at sunset, as the upper segment of a yellow sun gradually diminishes, the right and left corners of the segment become green; this colour gradually spreads inwards, becoming marine, until finally the last tip of the sun may appear almost greenish-blue" (NATURE, March 11, 1915, vol. 95, p. 35).

The same observation has been made by Dr. C. Braak ("Hemel en Dampkring," August, 1915, p. 52).

Both phenomena seem to be caused simply by atmospheric dispersion of light, as is explained, for example, in a most valuable article by Dr. A. A. Rambaut ("The Green Flash on the Horizon," *Symons's Meteorological Magazine*, No. 41, 1906).

The green flash and the "green surf" are not very common phenomena. Dispersion being always present, one may wonder why the green colouring is rather rare. Evershed discussing this fact writes:—"It seems to me very probable that this phenomenon is in some way connected with the abnormal conditions which at sea produce mirage effects. The layer of dense air in contact with the sea might produce total reflection for solar rays refracted from below the horizon, but the critical angle of reflection will depend on wave-length, and it is possible under certain conditions that the green rays may be totally reflected, whilst the red are refracted" (NATURE, May 15, 1915, vol. 95, p. 286).

Indeed, the green flash is often accompanied by strongly deformed images of the setting or the rising sun. Dr. Braak concludes that the green flash may be observed most frequently with a strongly notched limb of the sun. The occurrence of the distinct dip of the horizon at the time of observation of the green colouring of the surf agrees fairly well with these views. S. W. VISSER.

Weltevreden Observatory, Java, August 16.

Scientific Publication.

IN NATURE of September 8, p. 41, Dr. Brierley refers to a sore point of modern scientific workers, viz. the difficulties of scientific publication, and brings forward some, to use his own expression, "revolutionary" suggestions for overcoming these difficulties. I am fully convinced that Dr. Brierley's proposal to combat this evil by abandoning the practice of publishing in full works of scientific merit, deleting technical portions, and eliminating plates, and substituting for them summaries for the convenience of the "general scientific public," would prove to be a great hindrance to scientific progress if adopted.

Dr. Brierley's arguments for the adoption of this course are: (1) that the majority of papers have no permanent value in the advancement of science, and (2) that the special articles are not intelligible to workers in other branches of the same science.

It is very difficult to judge the value of scientific publications, and still more difficult to predict their possible value in the future. Mendel's paper, for instance, at the time of its publication in 1865, escaped notice, and could be termed "of no permanent value" by his contemporaries, but, as we know, it was "discovered" about twenty years later, and proved to be the foundation of the new doctrine of heredity. The truism that all scientific works, whether great or small, are the foundation on which the building of science is constructed stands good here.

It is highly important that all works should be published in full for the benefit of specialists all over the world, and not in "popular" form for the general scientific public, which will always find what it wants in general treatises and summaries. This would be impossible if, as Dr. Brierley suggests, the original memoirs were stored "in a kind of Somerset House for scientific records." Indeed, this would take us back to the Middle Ages.

The difficulties of scientific publication, however, are real, and I think that instead of *faire bonne mine à mauvais jeu*, as Dr. Brierley suggests, we should do our utmost to save the position and apply to the State for subsidy. We can surely afford to save our scientific literature, taking into account that scientific papers published in the whole country during one year are but a fraction of what is published daily in the Press in London alone. CECIL A. HOARE.

Behaviour in Lizards.

WE kept here this summer two common lizards (*Lacerta vivipara*), one a very active male, the other a female which was much less active because she was soon to give birth to a litter of young. One day I turned a batch of earwigs into the lizards' bowl, and a vigorous hunt ensued. When a lizard seizes any sort of prey it shakes it violently and repeatedly before swallowing it, thus incidentally advertising its success. At one moment it happened that the female was worrying an earwig when the male had none. He darted across and tried to snatch her earwig from her. She eluded him that time, but a few seconds later he tried again and succeeded. She made no attempt to get the earwig back; soon after he had swallowed it, however, she pounced on him and bit his elbow, tearing off a small piece of skin.

This was remarkable enough, since at all ordinary times these lizards never showed any sign of resentment—when, for example, one of them spread itself over the other in competing for a patch of sunlight. But about two minutes later something happened which surprised me still more. The female sighted an earwig sheltering half under a stone. Seeing the quick, purposeful turn of her head, the male ran up on to the stone and stood waiting. Neither moved for some seconds; then with a dart the female seized the male by the snout and held him for two or three seconds in spite of his struggles. The moment he freed himself she pounced on the earwig (which had not moved), and went through the usual actions of worrying, champing, and swallowing without further interference from the male.

On a cold day our lizards were scarcely more lively than newts. Temperature made all the difference to them. After half an hour of hot sunshine the male was as active and alert as a terrier; he would leap at flies and catch them in the air. This episode with the earwigs happened on a hot day, but even so it seemed to imply cerebral processes which one scarcely expects to find in such an animal as this small lizard.

E. LEONARD GILL.

Hancock Museum, Barras Bridge,
Newcastle-upon-Tyne, September 28.

Breeding Periods of Newt and Slow-worm.

ON September 27, when examining a ditch-pool which used to produce Hydra, I found a number of larvæ of the common newt varying in size from 11 to 20 mm., the smaller two-legged, probably less than two weeks old, the larger more advanced, with well-grown hind-legs.

The pool in question was dried up during the early summer, and until half an inch of rain on July 15 and 16 thoroughly wetted the ditches no newts could have bred there, although they were breeding in a deep quarry-hole within a hundred yards. We regularly obtain newt larvæ in July for class purposes, but the end of September seems unduly late.

Three possible explanations suggest themselves:—(1) The old newts in the locality have bred twice, (2) the spring-born newts have bred in late summer, or (3) newts belonging to the place in question have been able to hold up their spawn until favourable conditions occurred, which did not happen until the third week in July.

It would be interesting to have the observations of other naturalists on late breeding.

Last year, when the weather conditions were very different, slow-worms were late in breeding, gravid females occurring in the last week in September and newly hatched young in the second week in October.

RICHARD ELMHIRST.

Keppel, Millport, September 29.

The Highest Inhabited House.

I SHOULD very much doubt the accuracy of the statement in NATURE of September 15, p. 78, that a dwelling at 17,100 feet in the Andes is the highest inhabited house in the world. I feel confident that this can be claimed to be the case in the Himalayas, probably in the Karakoram or Ladak chains in the

north of Kashmir, where there are several high passes between the altitude of 18,000 and 19,000 ft. Within my own personal knowledge, the highest inhabited house (at least for a few weeks in the summer of each year) is near the summit of the Donkia Pass in the north of Sikkim, which is claimed by the Tibetans to be in Tibet, the height of the pass, according to the trigonometrical survey, being 18,100, and per aneroid 18,400 ft., at which height the amount of oxygen in the air is only about half that at sea-level. This is a stone hovel, and is occupied by a Tibetan guard or outpost of four or five men. It would be an easy matter for the inhabitants of the Tibetan Plateau to become acclimatised to that altitude, living, as they do, at a height of between 15,000 and 16,000 ft. I wonder, however, whether the rarefication of the atmosphere adversely affects their longevity, as is known to be the case with the monks of St. Bernard in the Swiss Alps.

Plymouth. W. HARCOURT-BATH.

THE remark found fault with by Mr. Harcourt-Bath is not mine, but the author's (Prof. Bowman, p. 52 of his work on "The Andes of Southern Peru").

The surest way of breaking a supposed world record is to publish it.

No doubt Prof. Bowman was not aware of Mr. Harcourt-Bath's experience in Tibet, otherwise he would not have stated that "the loftiest habitation in the world is in Peru." Both may be stone hovels, oblong and grass-thatched (there is a good photograph on p. 48), and both houses happened to hold five people. But whilst the Tibetan custom-house officers seem to be on duty for only a few weeks in the height of the season, the Peruvian shepherd family appear to use their place as a permanent residence. "At frequent intervals during the three months of winter snow falls during the night and terrific hailstorms in the late afternoon drive both shepherds and flocks to the shelter of leeward slopes or steep canyon walls."

The altitude of the Great St. Bernard Hospice is only 8,100 feet, about the same, or even less, than that of several large towns in Mexico where longevity is common. The self-sacrificing Augustine monks, resident for a limited number of years, do suffer, not from the rarefied air, but from the severe and vile climate and unheated rooms. THE REVIEWER.

The Use of the Classics.

IN discussing "Classical and Modern Education" (NATURE, September 8, p. 64) is there not some clear separation needed between two very different purposes of training in the classics? For knowledge of human nature, for political sense, for the feeling of the life of past times and its views, translations are practically as effective as original texts. The gain from using the original language is that of the æsthetic values and training. To revile "the inadequacy of translations" solely refers to the æsthetic values, and not to the practical values for life. What has been the effect on Europe of translations from Hebrew and Greek in the Bible? Do we talk of exposing their inadequacy as a reason for ignoring them? Why have many great scholars worked for years at translations if they thought them useless?

The cant of the grammarian trying to sink the classics under the weight of his own interests in language must be ignored. Let us have every child in a secondary school familiar with the great authors, from Herodotus to Ammianus, and then let those who have ability and time for language learn, as we learn Hebrew, off a familiar translation. W. M. F. P.

Indian Land Mollusca.

IN Lt.-Col. Godwin-Austin's instructive review of the latest volume in the official "Fauna of India" (NATURE, September 22, p. 106) he rightly lays stress on the importance of preliminary work in the preparation of what are supposed to be authentic handbooks. May I state that on hearing that Mr. Gude's volume was in actual preparation I wrote offering the loan of the material in the Indian Museum, including both the whole of Nevill's type-specimens and the vast accumulation of unnamed material obtained by the Zoological Survey of India in recent years. My offer was ignored or refused, apparently because the volume had to be out by a given date. I make this statement because I find that it is commonly believed that the Zoological Survey of India, of which I have the honour to be director, is in some way responsible for the "Fauna of British India." This is not the case. N. ANNANDALE.

Auroral Display of September 28–29.

DURING the whole night of September 28 I was photographing the spectra of stars. In the early morning, at 1.25 a.m. G.M.T., I was leaving the dome to proceed to another dome, in which Mr. W. B. Rimmer was working, when I observed a bright aurora low down on the northern horizon. I called Mr. Rimmer, and we observed it together.

The streamers, of a whitish hue, were scintillating and changing their intensities very rapidly; sometimes one streamer became very brilliant and faded away, and sometimes another. The whole phenomenon from the time I first observed it lasted about twenty-five minutes. Up to the time of writing I have seen no published record of this aurora.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory, Salcombe Hill, Sidmouth, South Devon, October 2.

The Isotopy of the Radio-elements.

THE nucleus-model of the radio-elements proposed by Lise Meitner (*Die Naturwissenschaften*, vol. 9, pp. 423–27, 1921) permits of the division of the radio-active isotopes into three, or even four, classes.

(1) Isotopes of the first class are elements which possess only the same nuclear charge and the same arrangement of their outer electrons, *e.g.* Ra and $MsTh_1$.

(2) Isotopes of the second class have, in addition, the same nuclear mass (*i.e.* the same atomic weight) and the same total number of nuclear "building stones," *e.g.* Io and UY.

(3) Isotopes of the third class still possess the same number of each nuclear building stone, but they have a different arrangement of these in the atomic nucleus, and thus also different chances of disintegrating, *e.g.* RaD and AcB.

(4) Isotopes of the fourth class would be elements possessing the same arrangement of the nuclear building stones in the atomic nucleus, and thus the same probability of disintegration. Such elements actually exist, but we have no available means of distinguishing between them. Hence we cannot at present designate them as isotopes (*e.g.* RaG and AcD).

The branching of the uranium family at U_{II} thus ends with the end-product of the radium- and actinium-family. This common end-product of the two radio-active families is lead with the atomic weight 206.

The more detailed discussion of this subject will appear in the *Zeitschrift für physikalische Chemie*.

M. L. NEUBURGER.

Neubaugasse 79, Vienna, VII., September 10.

Water Power Development.[1]

By PROF. A. H. GIBSON, D.Sc.

THE extent to which the water powers of the world have been investigated and developed during the past decade forms one of the striking engineering features of the period. Although falling or flowing water formed the earliest of the natural sources of energy to be utilised for industrial purposes, it is of interest to note that two-thirds of the water power at present in use has been developed within the last ten years.

The urgent demand for energy to supply the abnormal requirements of the war period, combined with the world shortage of fuel, was responsible for an unprecedented rate of development in most countries with available water-power resources, and especially in those countries normally dependent on imported fuel.

World's Available Water Power.—During the past few years much attention has been paid to statistics of available and developed water powers, and it appears that the available horse-power of the world is of the order of two hundred millions, of which approximately twenty-five millions is at present developed or is in course of development.

Power Available in Great Britain and in the British Empire.—With the noteworthy exceptions of Canada and New Zealand, practically nothing had been done, prior to 1915, by any part of the British Empire to develop or even systematically to investigate the possibilities of developing its water powers. It is true that a number of large installations had been constructed in India and Tasmania, but their aggregate output was relatively inconsiderable.

Since then, however, there has been a general tendency to initiate such investigations, and at the present time these are being carried out with varying degrees of thoroughness in India, Ceylon, Australia, South and East Africa, and British Guiana. While it is known that there is ample water power in Newfoundland, Nigeria, Rhodesia, Papua, and the Gold Coast, no very definite information is available, nor are any steps apparently being taken to obtain data in these countries.

The Water-power Committee of the Conjoint Board of Scientific Societies, which has been studying the state of investigation and development throughout the Empire since 1917, has, however, come to the conclusion that its total available water-power resources are at least equivalent to between fifty and seventy million horse-power.

Of the developed power in the Empire about 80 per cent. is in Canada. Throughout the remainder of its territories only about 700,000 horse-power is as yet developed, or only a little more than 1 per cent. of the power available, a figure which compares with about 24 per cent. for the whole of Europe, and 21 per cent. for North America, including Canada and the U.S.A. These figures sufficiently indicate the relatively large scope for future development.

With a view of ascertaining the resources of our own islands, a Board of Trade Water-power Resources Committee was appointed in 1918. This Committee, which has just presented its final report, has carried out preliminary surveys of as many of the more promising sites as its limited funds allowed, and has obtained data from the Board of Agriculture for Scotland, the Ordnance Survey Department, the Ministry of Munitions, and from civil engineers in private practice, regarding a large number of other sites.

As might be anticipated, Scotland, with its comparatively high rainfall, mountainous area, and natural lochs, possesses relatively greater possibilities than the remainder of the United Kingdom, and investigation has shown that it offers a number of comparatively large schemes. Nine of the more immediately promising of those examined by the Committee have an average output ranging from 7000 to 40,000 continuous 24-hour horse-power, and an aggregate capacity of 183,000 horse-power, while in every case the estimated cost of construction is such that power could be developed at a cost appreciably lower than from a coal-fired station built and operated under present-day conditions. The aggregate output of the Scottish schemes brought before the notice of the Committee, some of which, however, are not commercially feasible at the moment, is roughly 270,000 continuous horse-power.

In addition to these there are a very large number of other small schemes which have not yet been investigated,[2] and it is probably well within the mark to say that there are water-power sites in the country capable of developing the equivalent of 400,000 continuous horse-power, or 1,500,000 horse-power over a normal working week, at least as cheaply as from a coal-fired installation.

A number of attractive schemes are also available in North Wales, though these are in general more expensive than those in Scotland.

Owing to the general flatness of the gradients, there are, except possibly around Dartmoor, no schemes of any large individual magnitude in England, but there are a large number of powers ranging from 100 to 1000 horse-power which might be developed from river flow uncontrolled by storage.

Investigations on a few typical watersheds throughout England and Wales appear to show that the possible output averages approximately eight continuous horse-power per square mile of catchment area, which would be equivalent to an

[1] Abridged from the presidential address delivered to Section G (Engineering) of the British Association at Edinburgh on September 9.

[2] In a paper read before the Royal Society of Arts on January 25, 1918, Mr. A. Newlands gave a list of 122 potential Scottish schemes, the capacity of which he estimated, on a very conservative basis, at 375,000 horse-power.

aggregate of about 450,000 horse-power. Although much of this potential output is not commercially feasible, it would give the equivalent of 500,000 horse-power over a normal working week if only 30 per cent. of it were fully utilised.

In the report recently issued by the Irish Sub-Committee of the Board of Trade Water-power Committee it is estimated that approximately 500,000 continuous 24-hour horse-power is commercially available in Ireland, and that if utilised over a 48-hour working week, its capacity would be at least seven times as great as that of the engine power at present installed in the country for industrial purposes.

It appears then that, although the water-power possibilities of the United Kingdom are small in comparison with those of some more favoured countries, they are by no means so negligible as is commonly supposed, even in comparison with the present industrial steam-power resources of the country.

The capacity of the fuel-power plants installed for industrial and public utility services in the United Kingdom in 1907 was approximately 9·8 million horse-power. Allowing for an increase of 15 per cent. since then, and an average load factor of 35 per cent., this is equivalent to 32,000 million horse-power hours per annum, or to a continuous 24-hour output of only 3·7 million horse-power.

According to Sir Dugald Clerk, the average consumption of coal per horse-power hour in this country is about 3·9 lb., which, on the above basis, would involve a total annual consumption of fifty-five million tons for industrial purposes, not including railways or steamships.

Adopting this figure of 32,000 million horse-power hours as the annual demand for power for industrial purposes, it appears that the inland water-power resources of the United Kingdom are capable of supplying about 27 per cent. of this, a proportion which, in such an industrial country as our own, is somewhat surprisingly large.

Many of the small powers would be well adapted for linking up, as automatic or semi-automatic stations, into a general network of electricity supply, or for augmenting the output of municipal supply works, as has been done so successfully, for example, at Chester, Worcester, and Salisbury.

The development of the many small schemes available in the Scottish Highlands would probably have a great effect on the social life of the community. It would go far towards reviving and extending those small local industries which should form an essential feature of the ideal rural township. Commercially such undertakings may appear to be of small importance, but as a factor in promoting the welfare of the State, economical and political, their influence can hardly be over-estimated.

Some of the larger schemes in Scotland would lend themselves admirably to transmission to its industrial districts, while others, in close vicinity to the sea-board, would appear to be well adapted for supplying chemical, or electro-physical, or metallurgical processes.

Conservation.—The importance of water-power development from the point of view of conservation of natural resources requires no emphasis. When the value of coal purely as a chemical asset, or as a factor in the manufacture of such materials as iron and steel, cement, etc., is considered, its use as a fuel for power purposes, when any other equally cheap source of energy is available, would appear, indeed, to be unjustifiable.

The consumption of coal in the best modern steam plant of large size, giving continuous output, would be about nine tons per horse-power year, and on this basis the world's available water power if utilised would be equivalent to some 1,800,000,000 tons of coal per annum. The world's output of coal in 1913 was approximately 1,200,000,000 tons, of which about 500,000,000 tons were used for industrial power purposes, so that on this basis 55,000,000 continuous water horse-power would be equivalent to the world's industrial energy at that date.

Not only does the use of water power lead to a direct conservation of fuel resources, but it also serves to a notable degree to conserve man power. To take an extreme example, each of the 40,000 horse-power units now being installed at Niagara Falls will require for operation two men per shift. It is estimated that to produce the same power from a series of small factory steam plants, more than eight hundred men would be required to mine, hoist, screen, load, transport by rail, unload, and fire under boilers the coal required, while, if account be taken of the additional labour involved in horse transport, wear and tear of roads and of railroad tracks and rolling stock, the number would be considerably increased.

Uses of Hydro-Electric Energy.—While a large proportion of the energy developed from water power is utilised for industrial purposes and for lighting, power, and traction, an increasing proportion is being used for electro-chemical and electro-metallurgical processes.

In Norway the electro-chemical industry absorbed 770,000 horse-power in 1918, or approximately 75 per cent. of the total output, as compared with 1500 horse-power in 1910. Of this some 400,000 horse-power was utilised in nitrogen fixation alone.

The production of electric steel in the U.S.A. increased from 13,700 tons in 1909 to 24,000 tons in 1914, and to 511,000 tons in 1918, this latter quantity absorbing 300 million kw. hours, equivalent to almost 400,000 continuous horse-power.

In Canada, in 1918, the pulp and paper industry absorbed 450,000 horse-power, or 20 per cent. of the total, while the output of central electric stations amounted to 70 per cent. of the total.

The electrification, on a large scale, of trunk line railways is also a probability in the not distant future. In the U.S.A. 650 miles of the main line of the Chicago, Milwaukee, and St. Paul Railway, comprising 850 miles of track, have been electrified, the power for operation being

obtained from hydro-electric stations. In France much of the track of the Compagnie du Midi in the region of the Pyrenees has been electrified with the aid of water power; much of the Swiss railway system has been electrified; and the electrification of many other trunk lines on the European continent is at present under consideration.

Quite apart from the probable huge demand in the distant future for energy for the manufacture of artificial fertilisers by some system of nitrogen fixation, agriculture would appear to offer a promising field for the use of hydro-electric power.

Much energy is now being utilised in the U.S.A. for purely agricultural purposes. In California, for example, there is in effect one vast system of electrical supply extending over a distance of 800 miles with 7200 miles of high-tension transmission lines. This is fed from seventy-five hydro-electric stations, inter-connected with forty-seven steam plants, to give a total output of 785,000 horse-power. A further group of thirteen hydro-electric schemes now under construction will add another 520,000 horse-power. A large proportion of this power is used in agriculture, and a census in 1915 showed that electric motors equivalent to more than 190,000 horse-power were installed on Californian farms. The Californian rice industry is almost wholly dependent on irrigation made possible by electric pumping, while most of the mechanical processes involved in farming are being performed by electric power.

There can be little doubt that the economic development of many of our tropical dependencies is bound up in the development of their water-power resources. Not only would this enable railroads to be operated, irrigation schemes to be developed, and mineral deposits to be mined and worked, but it would also go far to solve the black labour problem, which promises to be one of some difficulty in the near future.

While those outlets for electrical energy which are now in sight promise to absorb all the energy which can be cheaply developed for many years to come, there are many other probable directions in which cheap energy would find a new and profitable outlet. Among these may be mentioned the purification of municipal water supplies, the sterilisation of sewage, the dehydration of food products, and the preservation of timber.

Research in Hydro-Electric Problems.—There are few branches of engineering in which research is more urgently required and in which it might be more directly useful.

Among the many questions still requiring investigation on the civil and mechanical side may be mentioned:—

1. *Turbines.*—Investigation of turbine corrosion as affected by the material and shape of the vanes.

Effect of erosion due to sand and silt.

Resistance to erosion offered by different materials and coatings.

Bucket design in low head high-speed turbines.

Draft tube design.

Investigation of the directions and velocities of flow in modern types of high-speed turbines.

Investigation of the degree of guidance as affected by the number of guide and runner vanes.

2. *Conduits and Pressure Tunnels.*—The design of large pipe lines under low heads with the view of reducing the weight of metal. The investigation of anti-corrosive coatings, so as to reduce the necessity for additional wall thickness to allow for corrosion.

Methods of strengthening large thin-walled pipes against bending and against external pressures.

Methods of lining open canals and of boring and lining pressure tunnels.

Effects of curvature in a canal or tunnel.

3. *Dams.*—Most efficient methods of construction and best form of section especially for rock-fill and earthen dams. Best methods of producing water tightness.

4. *Run-off Data.*—Since the possibility of designing an installation to develop the available power efficiently and economically depends in many cases essentially on the accuracy of the run-off data available, the possession of accurate data extending over a long series of years is of great value.

While such data may be obtained either from stream gaugings or from rainfall and evaporation records, the former method is by far the more reliable. For a reasonable degree of accuracy, however, records must be available extending over a long period of years, and at the present moment such data are available only in very few cases.

Where accurate rainfall and evaporation records are available, it is possible to obtain what is often a sufficiently close approximation to the run-off, but even rainfall records are not generally at hand where they are most required, and even in a district where such records are available, they are usually confined to easily accessible points, and are seldom extended to the higher levels of a catchment area where the rainfall is greatest. Even throughout the United Kingdom our knowledge of the rainfall at elevations exceeding 500 ft. is not satisfactory, and little definite is known concerning that at elevations exceeding 1000 ft.

In this country evaporation may account for between 20 and 50 per cent. of the annual rainfall, depending on the physical characteristics of the site, its exposure, mean temperature, and the type of surface covering. In some countries evaporation may account for anything up to 100 per cent. of the rainfall. As yet, however, few records are available as to the effect of the many variables involved. An investigation devoted to the question of evaporation from water surfaces, and from surfaces covered with bare soil and with various crops, under different conditions of wind, exposure, and mean temperature, would appear to be urgently needed. If this could be combined with an extension of Vermeulle's investigation into the relationship between rainfall, evaporation, and run-off on watersheds of a few characteristic types, it would do much towards enabling an accu-

rate estimate of the water-power possibilities of any given site to be predetermined.

Even more useful results would follow the initiation of a systematic scheme of gauging applied to all streams affording potential power sites.

Tidal Power.—The question of tidal power has received much attention during the last few years. In this country it has been considered by the Water-power Resources Committee of the Board of Trade, which has issued a special tidal power report dealing more particularly with a suggested scheme on the Severn. The outline of a specific scheme on the same estuary was published by the Ministry of Transport towards the end of 1920.

In France a special commission has been appointed by the Ministry of Public Works to consider the development of tidal power, and it has been decided to erect a 3000 kw. experimental plant on the coast of Brittany. With the view of encouraging research the Government proposes to grant concessions, where required, for the laying down of additional installations.

The tidal rise and fall around our coasts represents an enormous amount of energy, as may be exemplified by the fact that the power obtainable from the suggested Severn installation alone, for a period of eight hours daily throughout the year, would be of the order of 450,000 horse-power.

Many suggestions for utilising the tides by the use of current motors, float-operated air compressors, and the like have been made, but the only practicable means of utilising tidal energy on any large scale would appear to involve the provision of one or more dams, impounding the water in tidal basins, and the use of the impounded water to drive turbines.

The energy thus rendered available is, however, intermittent; the average working head is low and varies daily within very wide limits, while the maximum daily output varies widely as between spring and neap tides.

If some electro-chemical or electro-physical process were available, capable of utilising an intermittent energy supply subject to variations of this kind, the value of tidal power would be greatly increased. At the moment, however, no such process is commercially available, and in order to utilise any isolated tidal scheme for normal industrial application it is necessary to provide means for converting the variable output into a continuous supply constant throughout the normal working period.

Various schemes have been suggested for obtaining a continuous output by the co-ordinated operation of two or more tidal basins separated from each other and from the sea by dams with appropriate sluice gates. This method, however, can get over the difficulty of equalising the outputs of spring and neap tides only if it be arranged that the maximum rate of output is that governed by the working head at the lowest neap tide, in which case only a small fraction of the available energy is utilised.

When a single tidal basin is used it is necessary to provide some storage system to absorb a portion of the energy during the daily and fortnightly periods of maximum output, and for this purpose the most promising method at the moment appears to involve the use of an auxiliary high-level reservoir into which water is pumped when excess energy is available, to be used to drive secondary turbines as required. It is, however, possible that better methods may be devised. Storage by the use of electrically heated boilers has been suggested, and the whole field of storage is one which would probably well repay investigation.

If a sufficiently extensive electrical network were available, linking up a number of large steam and inland water power stations, a tidal power scheme might readily be connected into such a network without any storage being necessary, and this would appear to be a possibility which should not be overlooked in the case of our own country.

Investigation necessary.—A tidal power project on any large scale involves a number of special problems for the satisfactory solution of which our present data are inadequate.

Thus the effect of a barrage on the silting of a large estuary, and the exact effect on the level in the estuary and in the tidal basin at any given time can only be determined by experiment, either on a small installation, or preferably on a model of the large scheme.

Many of the hydraulic, mechanical, and electrical problems involved are comparatively new, and there is little practical experience to serve as a basis for their solution.

Among these may be mentioned:—

1. The most advantageous cycle of operations as regards working periods, mean head, and variations of head.

2. The methods of control and of sluice-gate operation.

3. Effect of changes of level due to wind or waves.

4. The best form of turbine and setting and the most economical turbine capacity.

5. The possibilities of undue corrosion of turbine parts in salt water.

6. The best method of operation; constant or variable speed.

7. Whether the generators shall be geared or direct driven.

8. Whether generation shall be by direct or alternating current.

The questions of interference with navigation and with fisheries, of utilising the dam for rail or road transport across the estuary, and, above all, economic questions connected with the cost of production, and the disposal of the output of such an installation, also require the most careful consideration before a scheme of any magnitude can be embarked upon with assurance of success.

In view of the magnitude of the interests involved, and of the fact that rough preliminary estimates indicate that to-day current even for an ordinary industrial load could be supplied from such an installation at a price lower than from a steam generating station giving the same output

with coal at its present price, it would appear desirable that these problems should receive adequate investigation at an early date.

Facilities for Research in Hydraulic and Cognate Problems.—In view of the considerations already outlined, and especially in view of the large part which British engineering will probably play in future water-power developments, the provision on an adequate scale at some institution in this country of facilities for research on hydraulic and cognate problems connected with the development of water power is worthy of serious attention.

At present the subject is treated in the curriculum of the engineering schools of one or two of our universities, but in no case is the laboratory equipment really adequate for the purpose in question.

What is required is a research laboratory with facilities for experiments on the flow of water on a fairly large scale; for carrying out turbine tests on models of sufficient capacity to serve as a basis for design; and, if possible, working in conjunction with one or more of the hydro-electric stations already in existence, or to be installed in the country, at which certain large-scale work might be carried out.

The provision of such a laboratory is at present under consideration in the United States, and in view of the rapidity with which the designs of hydraulic prime movers and their accessories are being improved at the moment, it would appear most desirable that the British designer, in order that the deservedly high status of his products should be maintained and enhanced, should at least have access to equal facilities, and, if necessary, be able to submit any outstanding problems to investigation by a specially trained staff.

The extent to which our various heat engine laboratories have been able of recent years to assist in the development of the internal combustion engine, and to which our experimental tanks have assisted in the development of the shipbuilding industry, is well known to most of us, and the provision of similar facilities to assist in the development of our hydro-electric industry would probably have equally good results in this connection.

The Danish Deep Sea Expedition.

THE Danish Deep Sea Expedition, which left Copenhagen on August 30 on board the new research steamer *Dana*, is expected to spend about ten months in the temperate and tropical parts of the North Atlantic. The object of the expedition is to carry out deep sea investigations in accordance with a scheme which was submitted by the leader of the expedition, Dr. Johs. Schmidt, to the International Council for the Exploration of the Sea during their meeting at Copenhagen in July last.

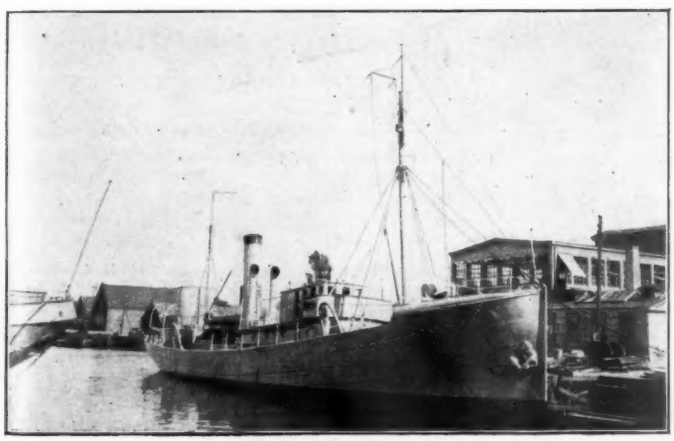

FIG. 1.—S.S. *Dana*.

The committee of the expedition consists of the members of the official Danish "Committee for the Study of the Sea" and of several other Danish men of science interested in oceanography. The president is Commander C. F. Drechsel, and the vice-president Vice-Admiral C. F. Wandel (leader of the Danish Ingolf Expedition in 1895–96). Admiral H.R.H. Prince Valdemar of Denmark is patron of the expedition. The expenses are being defrayed by funds supplied by various private persons and by the Danish Government annual grants for marine investigations in connection with the International Council for the Exploration of the Sea.

The ship of the expedition, the *Dana* (Fig. 1), of the Lord Mersey trawler type, was bought in England by the Danish Government to replace the old research steamer *Thor*, which was sold some years ago. The *Dana* has been equipped for marine research work at the Royal Dockyard, Copenhagen. She has a length of about 140 ft. between perpendiculars, and is 325 tons gross register. She carries a 600-h.p. triple expansion engine, giving her a speed of 9 knots. A large deck-house has been constructed, which contains two laboratories—a larger biological laboratory with accommodation for five workers, and a smaller one for hydrographical work with room for two—together with a mess-room for the scientific staff, and a cabin for the

leader of the expedition. Below deck are the cabins of the scientific staff, and store-rooms for the various instruments, fishing gears, collections, etc. The winches are worked by steam. A big trawl-winch placed forward has two drums, the smaller carrying 4000 metres of steel-wire 14 mm. in diameter for trawling at moderate depths, and the larger, carrying 10,000 metres of steel-wire tapering from 14 mm. to 7 mm. in diameter, to be used for greater depths. The three winches for vertical hauls (water-bottles, plankton nets, and sounding) are placed on the port side of the ship; one works the Lucas sounding machine and a drum carrying 6000 metres of phosphor-bronze wire; another is a small hand-winch to be used for the surface layers; and the third works a big drum carrying 10,000 metres of steel-wire 4 mm. in diameter. The steel-wire ropes have been supplied by Messrs. Craven and Speeding Bros., Sunderland, and the hydrographical instruments by the Laboratoire Hydrographique, Copenhagen, of which Prof. Martin Knudsen is director.

The *personnel* of the expedition is as follows:—Dr. Johs. Schmidt, leader of the expedition; Dr. J. N. Nielsen (Meteorological Institute, Copenhagen), hydrographer; P. Jespersen and A. V. Taaning (Danish Committee for the Study of the Sea); K. Stephensen (Zoological Museum, Copenhagen); J. Olsen (Polytechnic College, Copenhagen), assistant hydrographer. N. C. Andersen, ship's doctor, will also take part in the investigations. Prof. C. H. Ostenfeld expects to join the expedition later on during its stay in West Indian waters.

The *Dana* is under the command of Capt. G. Hansen, who served for many years as captain of the research steamer *Thor*.

Further particulars of the expedition are given in the subjoined *résumé* of a lecture delivered by Dr. Johs. Schmidt at the meeting of the International Council for the Exploration of the Sea at Copenhagen in July last.

The object of the expedition is to study the oceanographical conditions of the open North Atlantic Ocean. By oceanographical conditions is meant not only the physical, but also the biological conditions of the ocean, and in combining investigations of both it is hoped to obtain some insight into the problems of the relation of the biology of the ocean to some of the physical factors which it will be possible to trace. The principal aim, therefore, is of a very general nature. There are in addition, however, some tasks of a more special nature, the most important of which is an investigation of the oceanic portions of the life-histories of the common eel and the conger; further, the biology of other oceanic fishes, such as the various large scomberoids, dolphins, sword-fishes, sun-fishes, flying-fishes, and others, will be studied.

We know too little about the general biology of the ocean to be able to do our work from biological points of view alone; it has therefore been considered wiser to allow hydrographical views to dictate the course of the expedition. To put it briefly, we shall work biologically at each hydrographical station.

We do not expect to be able to pay much attention to the bottom of the ocean and its fauna; this would require more time than we have at our disposal. On the other hand, we shall try to concentrate our efforts on a study of the water-mass itself, which on an average has a depth of about 4000 metres in the North Atlantic. Our plan is to investigate not only the upper water layers, but also the intermediate layers and those covering the bottom, and we intend to do this in regard to their temperature, salinity, and gas-content, and also their fauna. Afterwards we shall compare the data we have obtained in this way in order to try to understand something of the physical factors which control the occurrence of the various pelagic communities of animals and plants, in regard to both their horizontal and vertical distribution. If possible, we shall pay special attention to the fauna of the deeper and deepest water layers of the ocean.

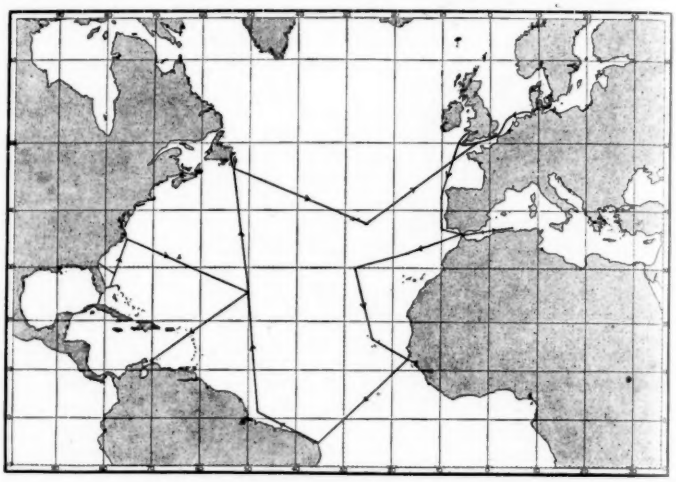

FIG. 2.—Planned routes of the *Dana* Expedition, 1921–22.

A current-chart of the North Atlantic shows that the most conspicuous feature is the great anticyclonic rotation of the superficial water-masses with the Sargasso Sea forming, so to speak, a centre of the rotation. Our plan is to investigate this great anticyclonic system, and we propose to do it by means of several cross-sections radiating from the centre, the Sargasso Sea, which, in more than one respect, will be our principal field of work (Fig. 2).

First, there is the inflow of water from the South Atlantic and the south equatorial current, which passes the boundary between the North and South Atlantic joining the current system of the North Atlantic. We propose to investigate carefully this boundary region between the North and South Atlantic, and we shall do this by means of a section between Africa and Brazil about the region where the Atlantic Ocean is narrowest. Through this section

enormous water-masses of South Atlantic origin are passing at the surface with great speed, and the cold water flowing along the bottom has, so far as we know, the same course. It follows from this that intermediate water-masses must move in the opposite direction, from the North to the South Atlantic. We hope to be able to do some useful work in this boundary region by studying the interaction between the water-masses of the northern and the southern Atlantic and their pelagic life.

The study of the equatorial current brings us in close contact with another important problem: the origin of the so-called Gulf Stream. We intend to study this by means of sections from the Sargasso Sea to the north coast of South America through the Caribbean Sea, and from the Sargasso Sea to the east coast of the United States. It seems clear that water passing both south and north of the West Indies must take part in the formation of the Gulf Stream. We hope that our sections taken before and after the junction of the water-masses coming from Florida Strait and of those passing north of the West Indies will help us to determine their relative importance in the formation of the Gulf Stream.

The centre of the North Atlantic rotation is the Sargasso Sea, a region which seems to merit a careful hydrographical investigation. Probably we shall be able to spend a good deal of time here on account of the eel investigations. It is impossible to say how long we shall be kept in the Sargasso Sea and West Indian waters, and it depends on this how much we shall be able to do during the homeward voyage of the expedition. If time permits we shall certainly make one or more cross-sections of the Gulf Stream or the Atlantic rotation, first one from the Sargasso Sea to Newfoundland, and perhaps another from there to the Azores.

This is a very brief sketch of our working scheme. Time will show to what extent we shall be able to carry it through.

Industrial Micro-biology.

IT is not much more than half a century since Pasteur began to study some chemical effects of micro-organisms which led him to the foundation of the new science of bacteriology. In the application of Pasteur's results to medicine this country has not been behind, and in the investigation of diseases due to protozoa it has been in the forefront. We have, however, neglected the application of Pasteur's work to industry. Yeast has been studied successfully in England, yet we cannot be said to lead in this department. Past British achievements in the chemistry of fermentation have been recently recorded by Prof. Armstrong in his Adrian Brown memorial lecture (see NATURE for July 28, p. 698). It is chiefly in the other industrial uses of micro-organisms that we are behind France and Germany in many respects; the Danish dairy industry has made far better use of bacteriology than has ours. Accordingly we must be grateful when a leading expert like Mr. Chaston Chapman reviews recent achievements and the present position in a series of lectures.[1]

Starting from the discovery of zymase by Büchner in 1897, Mr. Chapman discusses the work of Harden and his colleagues on its co-enzyme, and then refers to the German manufacture of glycerine by fermentation during the late war. In 1858 Pasteur first directed attention to the constant occurrence of glycerine in the fermentation of sugar solutions, and put the yield at about 3 per cent. of the sugar employed. Later 7 or 8 per cent. has been occasionally recorded, but Connstein and Lüdecke have shown that in the presence of various alkaline salts the yield of glycerine may regularly amount to 10 per cent.; in a concentrated solution of sodium sulphite it may even reach 36 per cent. of the sugar employed (usually molasses). A yield of 1000 tons a month is stated to have been attained during the war. The process was kept secret until after the armistice, and hence it is difficult to know to whom most credit should be assigned. Mr. Chapman states that Germany was actually producing large quantities of glycerine by fermentation early in 1917, and he thinks it probable that the initial experiments were made very shortly after—if not before—the outbreak of war. He also refers to a less known report from the laboratory of the Internal Revenue Bureau in Washington, dated May 6, 1918, which makes it clear that the American authorities had then also devoted much attention to the problem, and with considerable success.

In his lectures Mr. Chapman is not so much concerned with the commercial aspect of this manufacture as with the illustration it affords how, "by the application of the necessary study, an ancient and very familiar biological process may be made to yield as much as 40 per cent. of a substance which had hitherto been regarded merely as an unimportant by-product."

A second example of the application of modern biochemical methods to an ancient industry is furnished by the "amylo" process for the direct conversion of starch into alcohol by certain moulds. Such fungi have been used for centuries in China for the preparation of potable spirit from rice, for they produce not only an amylase, but also a zymase, combining, therefore, the functions of malt and of yeast. After an investigation by Calmette, the first large-scale trials were made in a French distillery in 1898, and for 1916 the output of alcohol by this process in France is stated to have been 665,232 hectolitres (14 million gallons). In this country the "amylo" process cannot be used, owing to Excise regulations. Mr. Chapman points the moral:

> No Government can afford to ignore scientific discoveries and industrial developments . . . and if there is one thing which, during recent years, has been made more apparent than another, it is that the country which is foremost in the encouragement of scientific men and in the utilisation of their dis-

[1] "Micro-organisms and some of their Industrial Uses." The Cantor Lectures. By A. Chaston Chapman. Journ. Roy. Soc. of Arts, 1921, vol. 69, pp. 581–89, 597–605, 609–19.

coveries will ultimately win the race at the expense of those which have been more neglectful in that respect. The possession by the latter of greater natural resources will only serve to stave off defeat for a time.

Moulds may be trained, under certain conditions, to produce various other compounds from sugar—for example, up to 50 per cent. of citric acid, also fumaric and pyruvic acids. Lactic acid and vinegar are, of course, largely manufactured by fermentation, but Mr. Chapman deplores the way in which these industries have neglected to apply modern scientific results. In the manufacture of vinegar, in particular, no real progress has been made since Pasteur's work of 1868.

We have been more successful with the production of acetone and butyl alcohol from starch, but this, too, originated in France in the experiments of Fernbach. Mr. Chapman discusses the process in some detail; in normal times its commercial success will depend on a means of utilising the butyl alcohol, which is produced in twice the quantity of the acetone.

Other applications of micro-biology are to agriculture, bread-making, tanning, sewage disposal, and food-production. Brewers' yeast is almost a waste product to the extent of 50,000 or 60,000 tons per annum in the United Kingdom, but is being used more and more as a cattle food and, in the shape of an extract, for human consumption. "Mineral yeast" (not a true yeast) was grown in Germany as a war food.

Finally, Mr. Chapman reiterates his plea (already made in a paper to the Society of Chemical Industry) for the foundation of a National Institute of Industrial Micro-biology, which should provide for the systematic prosecution of industrial research, be a centre for specialised training, and maintain a complete collection of pure cultures. "For far too many years we have been content to act as middlemen and agents, when we ought to have been manufacturers."

Obituary.

G. W. WALKER, F.R.S.

BY the death of Mr. GEORGE WALKER WALKER, physical science has lost a brilliant exponent of its rigidly exact experimental side, which his high mathematical attainment and inventive capacity enabled him to develop with marked success.

Mr. Walker was the only son of Mr. John Walker, of Aberdeen, and was a foundationer at the Robert Gordon's College, Aberdeen. He started life as a practical engineer, but, not caring for this, he obtained an appointment with Messrs. C. & P. H. Chalmers, of Aberdeen, where he remained one year. His interest in science, however, led him to pursue its study in the evening classes of Gordon's College, where he received so much help and encouragement that he obtained a national scholarship, which brought him in 1892 to the Royal College of Science, South Kensington, where, in due time, he obtained his associateship. While at South Kensington he so impressed Sir Arthur Rücker with his mathematical ability that he urged him to go to Cambridge, where he obtained a Sizarship at Trinity College. He was fourth wrangler in 1897, and Smith's prizeman and Isaac Newton student in 1899, and was appointed a fellow of Trinity in 1900. In 1901 he studied at Göttingen. From 1903 to 1908 he was lecturer in physics at Glasgow University. He was then appointed superintendent of Eskdalemuir Observatory, for which his prior training at South Kensington so admirably fitted him. There he remained four years. From 1912 to 1915 he was engaged on the new magnetic survey of the British Isles. He was elected a fellow of the Royal Society in 1913. He assisted the Earl of Berkeley in his laboratory at Boar's Hill in 1915, and became Halley lecturer in 1916.

In May, 1918, Mr. Walker was appointed chief scientific worker at the Royal Naval Mining School, Portsmouth, where the numerous and urgent problems connected with marine mines afforded abundant scope for his genius. His success in dealing with these was properly appreciated by the Superintendent of Mining and other naval officers, but this work, from its nature, is essentially confidential. In November, 1920, while engaged on experimental work at Falmouth, he contracted a chill, which developed into lung trouble and was the cause of an abscess, for which operation became necessary. He went into University College Hospital, Gower Street, in July last, where the shock due to two operations led to his death.

Besides his work on magnetic surveying, Mr. Walker was an authority on seismology, being also a warm admirer of Prince Galitzin. In 1904 he married the daughter of Mr. Gifford, of Aberdeen, who, with one son, survives him.

C. V. B.

DR. PETER COOPER HEWITT.

Dr. Peter Cooper Hewitt, who died in Paris on August 25 last, at the age of sixty years, was the son of a leading New York iron manufacturer and merchant well known as the promoter of many civic, educational, and philanthropic causes. His mother was the daughter of Peter Cooper, an inventor, manufacturer, and railroad builder, who presented New York with the Cooper Union for the advancement of art and science, now more usually known as Cooper Institute.

Dr. Cooper Hewitt was born on March 5, 1861, and was educated at the Stevens Institute of Technology at Hoboken, New Jersey, and at the Columbia University School of Mines. He early manifested a strong inclination towards mechanics, and his course of studies was directed towards the mechanical, chemical, and electrical sciences. One of his earliest inventions was in relation to improvements in the machinery em-

ployed in his grandfather's glue factory, and he followed this up with new forms of centrifugal machines, evaporators, and other devices for use in breweries. He made many experiments and a number of inventions in connection with motor vehicles and flying machines, and in later years devoted a considerable amount of time to the study of the helicopter.

About 1898 Dr. Cooper Hewitt directed his attention to electrical science, and became a contributor to scientific discovery in a diversity of fields, from wireless telegraphy and telephony to a special process for the electrical welding of steel. However, his name is probably best known in connection with his fundamental work relating to the mercury vapour arc which he brought into commercial use when he founded, in conjunction with the late Mr. George Westinghouse, the Cooper Hewitt Electric Company of New York, and the Westinghouse Cooper Hewitt Company, now known as Hewittic Electric Company, Limited, in England. His original work on the mercury vapour rectifier has been followed up until this apparatus has become a most useful adjunct to the dynamo, not only in street lighting but also in the serious work of power distribution, and it has not yet been brought to its full industrial value. A generation hence the world will have begun to reap some of the larger benefits conferred by the discoveries of this notable scientific worker.

WE regret to learn of the death of MR. BINGHAM NEWLAND, an observant and original naturalist, author of "What is Instinct?", which was reviewed some time ago in these columns. Mr. Newland held very strong views in regard to the infallibility of the subconscious mind in animals, and thought of this as strangely detached from individual testing, experimenting, and learning. Perhaps what he was feeling towards was a theory of the germinal origin of new departures in instinctive behaviour. Another of his amiable heresies was a belief in "mind-blending" or telepathic communication in birds, by means of which effective co-operation is achieved. Mr. Newland's original and independent mind was handicapped by ill-health, but he had the reward of all those who read deeply in the book of Nature.

Notes.

WE much regret that the reference to the Calcutta munitions case in last week's NATURE, p. 160, did not accurately represent Sir Thomas Holland's position in the matter. It was Sir Thomas Holland himself who, acting on the highest motives and after consultation with two members of the Viceroy's Council, ordered the withdrawal of the prosecution, but when all the facts are published we believe that the real reason for his action will reveal more than the stated reason as to the harm that might be done to Indian industrial development if it succeeded. As the Government of India could not support the view publicly stated, Sir Thomas Holland's resignation of the post of Minister of Industries naturally followed. Later, however, it was officially announced that the prosecution would not be proceeded with because "widespread commercial and industrial interests would be seriously affected," though when the Advocate-General withdrew from the case on August 6 he declared that all the charges could be proved. This decision seems, therefore, to support Sir Thomas Holland's action; and, notwithstanding the suggestion that the Minister of Industries should have received legal training, his reputation as a scientific administrator is safe with all who realise what the building-up of the Indian Munitions Board during the stress of war meant for India, the Entente Powers, and the final victory.

IN memory of those lost in R38 and in previous airships, a decision to establish a fund for airship research has been made by the council of the Royal Aeronautical Society. It is believed that such a course of action would most nearly meet the wishes of those who have lost relatives and friends in the disaster. It is important for the country that the lessons should not be lost, and the view of those most closely connected with airships is that analysis of the causes of the breaking of R38 in the air can give the foundation for a sound system of construction. Such a result would afford some comfort to the relatives of the officers and men who gave their lives for progress, and, in view of the well-known decision of the Air Ministry to cease all work on airships, it is desirable that others should take up the problems connected with their development. The memorial fund is to be devoted to this end. Over the signature of Lord Weir, the president of the society, an appeal for contributions has just been issued, with the suggestion that they should be sent to the Secretary, Royal Aeronautical Society, 7 Albemarle Street, London, W.1.

THE *Times* announces that Mr. Knud Rasmussen's ethnological expedition to the Canadian Arctic Archipelago left Godthaab, on the south-west coast of Greenland, on September 7 in the motor schooner *Sea King*. On his arrival in Greenland in the early summer Mr. Rasmussen went to Thule, near Cape York, to secure Eskimo, dogs, and furs for his expedition. Some delay was caused by pneumonia spreading among the Eskimo and causing two deaths. After a call on the coast of Labrador the *Sea King* will sail for Lyon Inlet, in the Melville Peninsula, which will be the base for the first winter. From there the little-known tribes around Fury and Hecla Strait will be visited by sledge journeys. In the spring of 1922 Mr. Rasmussen plans to move south to Chesterfield Inlet in order to pick up stores sent north by the Hudson Bay Co., and he will then visit tribes in the Barren Lands and along the shores

of Coronation Gulf before returning to Lyon Inlet. The next news of the expedition may be expected from St. John's, Newfoundland, when the *Sea King* returns during the autumn.

THE Royal Microscopical Society has arranged to include in the programme of ordinary meetings during the coming session a series of papers dealing with the practical uses of the microscope in industrial research. A provisional list has been issued of the communications to be read, and from this it appears that a wide range of subjects will be covered by a number of competent authorities. Metallurgy, physical optics, glass, leather, coal, medical research, and brewing, all in relation to the microscope, are among the topics which will be discussed. The first two papers will be read on October 19, when Dr. L. T. Hogben will read a communication entitled: "Preliminary Account of the Spermatogenesis of Sphenodon," and Mr. D. M. Stump will communicate a paper entitled "An Application of Polarised Light to Resolution with the Compound Microscope." Announcements of further papers will be made from time to time in the Diary of Societies published in our columns.

AT a recent meeting of the American Astronomical Society, held at Middletown, Connecticut, Prof. C. V. L. Charlier was elected an honorary member. The only other living astronomers who have been thus honoured are Prof. J. C. Kapteyn and Sir Frank Dyson.

THE fourth annual Streatfeild memorial lecture is to be delivered at the Finsbury Technical College, Leonard Street, E.C.2, by Mr. W. P. Dreaper, on Thursday, October 20, at 4 o'clock. The subject will be "Chemical Industry a Branch of Science." Admission will be free.

THE first general meeting of the Society for Constructive Birth Control and Racial Progress will be held on Thursday, October 13, at 8 p.m., at the Lecture Room, Hotel Cecil, Strand, W.C., when Dr. Marie Stopes will deliver her presidential address, entitled, "Anecdotes of the Past, Present, and Future of Birth Control."

THE Committee of Privy Council for Medical Research has appointed Sir F. W. Andrewes and Sir Cuthbert Wallace to fill the vacancies on the Medical Research Council caused by the retirement of Mr. C. J. Bond and Prof. W. Bullock, in accordance with the provisions for rotation made in the Royal Charter under which the council is incorporated.

IT is announced that Mr. D. Prain, agriculturist, Nyasaland, has been appointed to be senior district agricultural officer in Tanganyika Territory; Mr. H. A. Dade to be assistant mycologist in the Department of Agriculture, Gold Coast; and Mr. J. A. Robotham to be assistant agricultural superintendent, St. Kitts-Nevis.

THE New York correspondent of the *Times* reports that at Dayton, Ohio, Lieut. J. Macready made a new height record when flying a Lapero biplane on September 28. Ice formed in his oxygen tank at 39,000 ft., but his engine carried him on until the altimeter registered 40,800 ft. Lieut. Macready came down and made a successful landing after being 1h. 47m. in the air.

CHARLES DARWIN'S birthplace, known as The Mount, Shrewsbury, situated in that part of the town known as Frankwell, has been purchased by H.M. Office of Works. The house was built about 1800, and at the time when Sir Francis Darwin wrote, in 1887, "The Life and Letters of Charles Darwin," it had undergone but little alteration. It was "a large, plain, square, red-brick house, of which the most attractive feature" was "the pretty greenhouse, opening out of the morning-room."

IT is announced in the *Revue Scientifique* of September 24 that the first award of the Marcel Benoist prize of 20,000 francs has been made to M. Maurice Arthus, director of the Institute of Physiology at Geneva. The prize was founded by M. Benoist, of Paris, who bequeathed his whole fortune to the Federal Council of Switzerland in recognition of the care and attention which he received in that country. An award will be made annually to the man of science who, having been domiciled in Switzerland for five years, is judged to have made the most noteworthy contribution to science, particularly in relation to human life, during the preceding year.

AT the recent meeting of the Hull Museums Committee the curator reported that when in London recently he heard that the specimens in the museum at the Royal Albert Institute, Windsor, were in rooms which were required for other purposes, and that there was an opportunity of obtaining the collections. He consequently visited Windsor, with the result that the whole of the specimens are now in Hull, and among them are many valuable additions to the antiquities and geological and natural history series already there. Particular mention may be made of some pre-historic Bronze Age and Stone Age weapons, a large collection of Roman lamps and pottery, Greek vases, and a miscellaneous series of medieval antiquities. Otherwise the objects are such as were to be found in museums of this character in the early part of the last century. Fortunately a handbook to the collections, written by Mr. J. Lundy, was published many years ago.

A COMPANY has been incorporated, under the name of British Trade Ship, Ltd., with Earl Grey as chairman, for the purpose of carrying out the project of organising a floating exhibition of British goods which shall visit the chief ports of the world. A new vessel of 20,000 tons register is to be constructed in the yards of Messrs. Swan, Hunter and Wigham Richardson, Ltd., and it is intended that she shall leave the Thames in August, 1923, on a tour of more than 42,000 miles, returning to London in February, 1925. South America, South Africa, Australia, New Zealand, Fiji, and Japan will be visited on the outward voyage, and the ship will return *via* China, India, and the

Suez Canal. The ship will be 550 ft. long, with an extreme breadth of 74 ft. 9½ in., and a moulded depth of 44 ft. 6 in. to the shelter deck. She will be built after the style of a first-class liner so far as accommodation for trade representatives, etc., is concerned, but her special feature will be four exhibition decks, long clear spaces the full width and the full effective length of the vessel, and 10 ft. in height between decks. Compressed air, electricity, running shafting, and probably steam and hydraulic power will be provided for exhibitors who may desire to give working demonstrations of their machinery. Other interesting particulars regarding this vessel are given in *Engineering* for September 23. There is no doubt that the scheme will be valuable in carrying out much-needed propagandist work.

"SPEECH in the Silent World" is the title of an address delivered by Sir Leslie Mackenzie at the annual meeting of the Edinburgh Royal Institution for the Deaf and Dumb, in which teaching the deaf mute to articulate is discussed. The author believes that the impulse to speak is almost universal. The normal child at a certain stage acquires language with extraordinary rapidity, and the same obtains with deaf children if they be of normal brain. For the latter the problem of training in articulate speech is like the problem of training in the speech of gesture, namely, how to use a series of motions to express a meaning. Through the series of motions visible to the eye the teacher of lip-speech trains the vocal organs in the formation of sounds with meaning, and the teacher of lip-speech, working on the irresistible impulse towards expression, develops with amazing rapidity the powers of articulation. The training should preferably commence at the age of two or three years; progress is then much more rapid, for as time elapses the impulse becomes less and less marked, and the training in articulate speech correspondingly more difficult. The directors of the Edinburgh Royal Institution last year opened a nursery school so that the training in lip-speech might be commenced at an early stage of life.

THE presidential address delivered by Sir Baldwin Spencer at the meeting of the Australian Association for the Advancement of Science, held at Hobart, Melbourne, in January last, is devoted to the tangled problems of Australian ethnology. After a succinct review of the work of various explorers he gives the well-needed caution that "investigations carried on amongst the remains of tribes that have been long in contact with white men are liable to be very misleading." As regards land tenure, statements of individual ownership should be accepted with caution, as natives perceive that the private possession of land among white men is evidently a sign of superiority. The existence of a number of local tribes, each with its own distinct dialect, is a difficult problem. The desiccation of the central area probably led to the isolation of its inhabitants from the coastal people, and the progressive deterioration of the climate led to the occupation of districts less exposed to drought, where the absence of a written language encouraged the growth of dialects. The original migrants probably entered Australia at the north-east in Pliocene or very early Pleistocene times. The theory of Dr. Rivers that "the history of Australian culture and its present nature become far easier to understand if there has been a gradual infiltration of seafaring peoples, starting from many points on the coast," is dismissed with the remark: "To anyone who has had experience of the wild native tribes on the northern, north-western, and north-eastern coasts there is very considerable difficulty in accepting the suggestion of Dr. Rivers that small seafaring parties landing at various points would be able, even if they could find sufficient food to live upon, to influence the aboriginals. Personally, at that early date, I should have been very sorry to have formed a member of any such small party." This address is very interesting and instructive, and may be commended to all students of Australian ethnology.

WITH the rapid development of water-power utilisation in Italy, increasing attention is being directed to better methods of inland waterway transport and the improvement of existing ports and the planning of new ones. With a view of facilitating a thorough discussion of questions bearing on this subject, the Associazione Nazionale per i Congressi di Navigazione (National Association for Congresses on Navigation) is holding a Congress on "Inland Navigation and Ports" at Ravenna on October 22–26. The Congress, on this occasion, will be confined to questions relating to inland navigation in Northern Italy and the ports of Ravenna, Ferrara, and Venice. A number of papers will be read, visits paid to port works, and, if time permits, an exhibition relative to inland navigation and port works will be arranged. Among the subjects for discussion are: "A Systematic Plan for the Control of the Waterways of Northern Italy"; "Types and Standard Dimensions of Art-works on Inland Waterways"; "Utilisation of Existing Subsidiary Waterways in Northern Italy"; "Suggested Regulations for Inland Navigation on Existing Waterways"; "The Administrative Control of Maritime Ports"; "Distribution and Co-ordination of the Functions of the large Adriatic Ports"; "Works carried out or schemes approved for the Construction and Improvement of Maritime Ports in Italy"; "Present State of Inland Navigation Works recently completed or in course of Construction in Italy"; "Methods of facilitating the Entry of Ships into Ports in Foggy Weather," etc. Those interested may enrol as temporary members of the Congress on payment of 25 lire (100 lire for a company or association). The papers will be printed and circulated to members of the Congress. The general secretary of the Congress is Signor Mario Beretta, Via della Signora 12, Milan.

IN an article on "The Whaling Industry" in the *Statist* for September 3 Mr. A. F. Bearpark advocates a complete scientific investigation of the industry with the view of preventing its extinction, and not, as the writer frankly admits, in order that whales may be preserved from extermination. He does not believe that the latter eventuality is to be feared from the operations of whalers, because economic con-

siderations would bring about the stoppage of the industry before that could occur. He outlines a schedule of information to be demanded as a basis for legislation when licences for whaling are issued, and urges the infliction of heavy penalties for incomplete and inaccurate returns. Most of the information asked for by Mr. Bearpark is, we believe, already supplied by whaling companies, and the masterly analysis of the statistics for the last eight years presented by Sir Sidney Harmer to the recent meeting of the British Association at Edinburgh does not bear out Mr. Bearpark's contention that the extinction of whales is not to be feared from the operations of whalers. The contrary is, unfortunately, only too clearly probable. Whether from the point of view of the naturalist or the whaler, legislation to regulate the industry is undoubtedly necessary, particularly, as Mr. Bearpark points out and as Sir Sidney Harmer would agree, to prevent the deplorable waste which is associated with floating factories. A little friendly co-operation should result in legislation which aims at the consummation of the desires of both sides, the preservation of whales as part of the marine fauna, and the establishment of the whaling industry on a sound and permanent basis.

RESULTS of meteorological observations made at the Radcliffe Observatory, Oxford, under the direction of Dr. A. A. Rambaut, are published by order of the Radcliffe Trustees for the five years 1916–20. The volume contains daily observations of barometer, air, and evaporation temperatures, solar and terrestrial radiation temperatures, wind direction and velocity, cloud, hours of bright sunshine, and rainfall. Observations of ozone are given twice daily, and there is a summary of the weather and remarkable phenomena. In addition to these daily observations, mean monthly readings of the barometer are given for each of the five years, and for comparison the monthly means for sixty-six years, and similar means of the dry- and wet-bulb thermometers. The highest and lowest air temperatures are also given for the separate months and the monthly amounts of rain, with the means for seventy years, together with similar means of the amount of cloud, bright sunshine, and ozone. The mean amounts of ozone for the several months of the five years 1916–20 are so decidedly higher than the mean for the fifty-four years that it almost suggests that some difference may have occurred in the basis of registration. The lowest temperatures on the grass are tabulated for each month for the sixty years from 1861 to 1920, and the monthly maximum and minimum temperatures for each month in the last seventy years, with the monthly duration of sunshine for each of the last forty years. A diagram is given showing the triennial variation of the velocity of the wind, barometric pressure, and rainfall at Oxford for the years 1859–1920. Such details as those contained in the volume add much to our knowledge of the world's meteorology.

THE Geological Survey of the Union of South Africa has issued Memoir No. 16, which contains a description of the Mutue Fides-Stavoren Tinfields by Dr. Percy A. Wagner. This name has been given to what appears to be one of the most important portions of the Olifants River Tinfields, and the report contains a description of the deposits, their mineralogy, mode of occurrence, etc. The author appears to have come to the conclusion that this field is never likely to play any really important part in the tin production of the world, or even to equal some of the other tinfields of South Africa, but that, nevertheless, it is likely for a considerable time to come to produce moderate quantities of tinstone as well as ores of tungsten and copper.

THE September issue of the *American Journal of Science* contains a paper by Mr. W. D. Lambert, of the United States Coast and Geodetic Survey, in which some of the consequences of the rotation of the earth are pointed out in a way which will be much appreciated by readers not familiar with the mathematical developments of geodesy. The surface of the ocean is not strictly spheroidal, but is rather the rounding down towards a spherical form of a lens-shaped surface with its diameter one and a half times its thickness. If an elongated body of slightly less density than the ocean floats on the ocean, the forces on it tend to make it move towards the equator and set itself with its length along the meridian in latitudes greater than 45°, and at right angles to the meridian in latitudes less than 45°. The motion of the rod of an Eötvös balance tending to set in the prime vertical is also explained, and the possibilities which the modified balance opens up of detecting and studying local irregularities in the distribution of matter near the earth's surface are clearly pointed out.

IT is now well recognised that cod-liver and other fish oils are exceptionally rich in the vitamin-A which promotes growth. So far as is known at present, the only phase in the cycle of living organisms at which this substance is synthesised is that associated with the development of chlorophyll in plants. There is direct evidence that mammals cannot make it, and there is no evidence that any other animals can, though our information on this latter point is very scanty. In an interesting paper (*Biochemical Journal*, vol. 15, p. 530) which opens up a number of problems in the general biology of the growth-substance, K. H. Coward and J. C. Drummond raise the question as to where the fish get their store of vitamin from. They show by appropriate feeding experiments that green seaweeds contain a good deal, and they suggest that these form the ultimate source of the virtues of cod-liver oil, the cod obtaining them through the smaller animals on which it feeds by an unknown number of links, the last of which feeds on the seaweed. Attractive as it is at first sight, it may be doubted whether this explanation is quantitatively sound; the amount of seaweed in the sea is relatively very small, and it is indeed only a small fraction of even shallow waters that have a substantial growth on the bottom. It would be interesting to know the vitaminic relations of the plankton and some of the marine invertebrates.

A WORK that should be of scientific and economic importance is included in the list of announcements of the Oxford University Press, viz. :—"Ocean Research and the Great Fisheries," by G. C. L. Howell. Among the subjects dealt with are the great fisheries, the organisation of ocean research, the plaice question, the turbot and turbot culture, the soles, the haddock problem, Norwegian haddock investigation, the cod, the coalfish or saithe, the halibut, the hake fisheries, business men on hake problems, Dr. le Danois on the hake, the skates and rays, the ling, the whiting, and lemon soles. Another book appealing to readers of NATURE is "The Life and Scientific Correspondence of James Stirling," by C. Tweedie.

MESSRS. L. OERTLING, LTD., Turnmill Street, London, E.C.1, inform us that Sir Ernest Shackleton has taken an Oertling balance with him on the *Quest*. An Oertling balance was also taken by Admiral Sir George Nares on his expedition in 1873, and the same balance was used by the late Capt. Scott in his expedition in 1901, and during the war it was used in the Science Museum at South Kensington. It speaks well for the trustworthiness of an instrument which can be of service fifty years after the date of its manufacture.

MESSRS. GEORGE BELL AND SONS, LTD., announce for early publication a revised and enlarged edition of Madison Grant's "The Passing of the Great Race; or, the Racial Basis of European History," the first edition of which work was reviewed in NATURE of August 23, 1917 (p. 502). The new edition will contain a supplement of more than 100 pages, giving references to and quotations from authorities upon the subject treated of by the author.

THE firm of Mr. George Ellison, of Perry Parr, Birmingham, has prepared a number of lantern-slides illustrating various types of electric control gear such as oil rotor starters, switchboards, circuit-breakers, etc.; there are also some views of works. These slides will be loaned to engineering and technical societies and technical colleges upon application being made to the firm at the above address.

WE have received from Messrs. Reynolds and Branson, Ltd. (13 Briggate, Leeds) their catalogue of first-aid requisites. It includes a series of specially designed cases containing sterilised dressings and other requisites to meet the requirements of Home Office Orders as applied to factories and works.

THE latest catalogue (No. 419) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, contains particulars of some 500 works dealing with Central and South America. It will doubtless be of service to those taking an interest in the history and exploration of the regions referred to.

Our Astronomical Column.

ANTARES AND ITS COMPANION.—Mr. F. G. Pease has measured the diameter of this star by the interferometer method at Mount Wilson. He obtains the result 0·040″, nearly the same as that for Betelgeuse. The parallax is uncertain, but it is believed to be about 0·009″, which makes the linear diameter 400,000,000 miles. W. S. Adams and A. H. Joy have succeeded in photographing the spectrum of the companion, at the Cassegrain focus of the 100-inch. It is of early helium type B 3, the H and K lines of calcium being fairly sharp, the other lines wide and hazy. Adams and Joy give −2·7 as the absolute magnitude of the primary, which gives +3·2 for the companion. This is unusually faint for a B-type star. The companion is 3·2″ distant, and the common proper motion indicates physical connection. There is no distinct evidence of orbital motion in seventy years.

THE BRIGHT OBJECT NEAR THE SUN.—Dr. W. Bell Dawson writes from Ottawa stating that he saw a bright object low in the west in unusually clear air just after sunset on September 4, which he assumes to be the same as that observed at Mount Hamilton on August 7. The identity seems unlikely; Dr. Dawson's object may have been Mercury (R.A. 11h. 36m.: N. Decl. 3° 38′), or Jupiter (R.A. 11h. 45m.: N. Decl. 2° 48′; the Sun was in R.A. 10h. 53m.: N. Decl. 7° 6′). However, it is well to put the observation on record, the mystery of the Mount Hamilton object being still unsolved.

STUDIES OF NEBULÆ AND CLUSTERS.—M. Camille Flammarion has in recent months contributed a series of illustrated articles on this subject to *L'Astronomie*. The September issue deals with the interesting nebula N.G.C. 4594 in Virgo, the discovery of which is usually attributed to Sir W. Herschel in 1784. M. Flammarion has, however, discovered a manuscript note in Messier's handwriting, showing that his assistant Méchain found it on May 11, 1781. It is suggested that it should be called Messier 104.

It belongs to the class known as spindle nebulæ; they are of regular outline, long and narrow; the width is greatest in the centre, and tapers nearly to a point at each end. Two drawings and two photographs of the nebula are reproduced, the former by Sir J. Herschel and Lassell, the latter by Dr. Isaac Roberts and Mr. F. G. Pease. All four are in good accord, but the photographs show considerably greater width in the centre. Many of the spindle nebulæ, including this one, have a dark central strip, with nearly parallel edges, dividing them longitudinally into two parts. It seems scarcely possible dynamically that this should be a real division, and it is generally assumed that there is an equatorial zone of dark occulting matter encompassing the nebula.

It is believed that the spindles are spirals seen edgewise, in which case they are important as affording a knowledge of the cross-section of the latter; the thickness in the central regions is one-third or one-fourth of the equatorial diameter; this is much the same proportion as that assigned by star-gauges to our own stellar system. This is one of the arguments used in support of the view that the spirals are external galaxies. It has further been suggested that the galaxy may have an outer belt of absorbing matter, like that seen in the spindle nebulæ, which would explain the absence of spiral nebulæ in the galactic neighbourhood.

Sir J. Herschel erroneously gave the position angle of the nebula M. 104 as 102°. The photographs give 80°; there has been no real change, since Smyth in 1837 and Lassell in 1862 both noted it as parallel to the equator.

International Meteorological Committee.

THE first meeting, for general purposes, of the International Committee appointed by the Conference of Directors of Meteorological Institutes and Observatories held in Paris in 1919, in continuation of the committees which have organised international meteorology from the Congress of Vienna in 1873, was held during the week September 12–17 in London. Those attending as members were Sir Napier Shaw (president), M. A. Angot (vice-president), Prof. E. van Everdingen (secretary), Col. F. A. Chaves, Director Hesselberg, Comdt. Jaumotte, Dr. Maurer, and Capt. Ryder; as presidents of commissions, Prof. Bjerknes (Bergen), of the Commission for the Study of the Upper Air; Col. E. Gold, of the Commission for Weather Telegraphy; and Col. Saconney, of the Commission for Aerial Navigation; and, as savants whose assistance would be useful in the deliberations of the committee, Col. Delcambre, Dr. Gorczynski, Col. Matteuzzi, Dr. Melander, Prof. T. Okada, Dr. G. C. Simpson, Dr. A. Wallén, Dr. S. Fujiwhara, and Mr. L. F. Richardson.

The business opened with the election of two members of the committee—Director Wallén, of Sweden, to fill the sixteenth place, which was left vacant at Paris, and Prof. T. Okada, of Tokyo, in succession to Prof. Nakamura, of the same institute, resigned. It concluded with the election of Col. Delcambre, Director of the Office Météorologique National of France, and Dr. G. C. Simpson, Director of the Meteorological Office, London, to the places vacated at the end of the meeting by M. Alfred Angot, Directeur honoraire du Bureau Central Météorologique, and by Sir Napier Shaw, now professor of meteorology in the Royal College of Science, under the rule which requires the sixteen (ultimately twenty) members of the committee to belong to different countries and to be directors of independent meteorological institutions.

Apologies for absence were received from Prof. Eginitis, of Athens; Mr. H. A. Hunt, of Melbourne; Prof. Nakamura, of Tokyo; Prof. Palazzo, of Rome; Sir Frederick Stupart, of Toronto; and Dr. G. T. Walker, of Simla.

The chief business of the meeting was to receive reports from the commissions for special departments of meteorological work. Of these, two—namely, the Commission for the Study of the Upper Air and the Commission for the Meteorology of the Polar Regions—had met in Bergen in the last week of July of this year. The Commission for Weather Telegraphy had held a meeting in London in November of last year to formulate new codes for the transmission of information, from land stations and from ships respectively, in pursuance of certain provisions of the Peace Treaty. That commission held further meetings in the week ending September 10 of this year for the discussion of details in the light of experience already obtained. In the same week meetings were held of the Commission for Maritime Meteorology, for Aerial Navigation, and a joint meeting of the three commissions concerned with the speedy transmission of meteorological information was held to consider points of common interest. Meetings of the Commission for Réseau Mondial were also held.

The chief recommendations discussed were:—(1) By the Commission for the Study of the Upper Air, inviting observations of the upper air from land and sea and proposing to resuscitate the practice of preparing and issuing an international publication of the results for the upper air contributed by the various countries, and to obtain subventions for the purpose of providing for the cost of compilation and editing, as well as of printing and distributing. The total annual sum required was estimated at 4000*l.* sterling. (2) By the Commission for Weather Telegraphy, setting out an agreed code for land stations and, jointly with the Commissions for Maritime Meteorology and Aerial Navigation, two alternative codes for ships at sea, between which a selection should be ultimately made so that one form of message shall become universal. (3) By the Commission for Maritime Meteorology, proposing suitable co-operation for the collection of oceanographical data. The formulation of the codes and the approach to a final solution of the questions involved are a matter for warm congratulation.

The Commission for the Réseau Mondial recorded its thanks for the volumes which the British Meteorological Office had already published, and expressed a desire for their continuance. At the same time the question of daily charts for the globe was raised, and Col. Matteuzzi urged the daily issue of reports of pilot-balloons with the object of obtaining a general view of the streams of air.

On the initiative of Col. Delcambre, a new commission was set up for the further study of clouds; and on the initiative of Col. Saconney it was recommended that rewards should be offered for valuable observations, notes, or photographs spontaneously contributed by aviators and others.

Prof. Okada, on behalf of Prof. Nakamura, urged the industrial and economic, as well as the scientific, importance of a speedy publication by all institutes of a summary of the weather month by month.

Some time was devoted to the question of the application of meteorology to agriculture, and the commission appointed at Paris for that study was enlarged by the addition of a number of names of experts on the agricultural or biological side of the various subjects involved. It was also decided that application of the study of weather to forestry should be included.

The report of the Polar Commission dealt with the provision that had been made at Obispo, Spitsbergen, Bear Island, Jan Mayen, Lerwick, and in northern Canada and elsewhere, for geophysical investigations during Amundsen's proposed drift across the Pole. It was decided to unite the Polar Commission with the Commission du Réseau Mondial. Dr. Simpson was appointed president of the united commission.

At the meeting on September 15 Col. F. A. Chaves, of the Azores, well known to all meteorologists for his enthusiasm for the subject, announced that the Portuguese Government had appointed Sir Napier Shaw, M. Angot, and Prof. E. van Everdingen to the dignity of Commander of the Order of Santiago da Espada in recognition of their services to international meteorology, and that he expected to be able to present the insignia on behalf of his Government before the close of the meeting.

When the general business of the meeting was concluded, and after the completion of the number of sixteen members, it became necessary to hold a meeting of the reconstituted committee in order to make appointments to the presidency and vice-presidency, which had become vacant by the retirement of Sir Napier Shaw and M. Angot. By a unanimous vote of the committee Sir Napier Shaw was invited, and consented, to act as president until the conference in 1923. Prof. E. van Everdingen was elected vice-president, and Dr. Hesselberg, Director of the Meteorological Institute, Christiania, secretary.

It was agreed, on the invitation of Prof. E. van

Everdingen, that a conference of directors of meteorological institutes and observatories should be held at Utrecht in 1923, either in the spring or autumn as may be found the more convenient.

The meetings of the committee were held in the library of the Meteorological Office, South Kensington, and those of the commissions in the council-room of the Air Ministry in Kingsway.

Dr. and Mrs. Simpson received the visitors at the Meteorological Office, South Kensington, on the evening of Wednesday, September 7. The Government entertained them on September 9 at a luncheon, at which Sir Frederick Sykes, Controller-General of Civil Aviation, welcomed them. Capt. C. J. P. Cave, of Stoner Hill, Petersfield, gave a luncheon in their honour on September 15, and the evening of September 16 was devoted to a dinner given by the president.

The International Illumination Commission.

THE first technical session of the International Illumination Commission was held in Paris on July 4–8, many delegates from the chief countries of Europe and the United States being present. The proceedings were opened by the Minister of Public Works in the name of the French Republic.

Dr. E. P. Hyde (U.S.A.) was elected president for the forthcoming period, M. Th. Vautier being nominated an honorary president in recognition of his past work on behalf of the Commission; and Mr. C. C. Paterson was elected hon. secretary. After the conclusion of formal business international technical committees were nominated to deal with the subjects of nomenclature and symbols, heterochromatic photometry, factory and school lighting, and automobile headlights. The unit of candle-power at present in use in this country, in France, and in the United States was adopted for international purposes, and is to be known as the "international candle." It is maintained by means of electric incandescent lamps at the national laboratories of the three countries named. Definitions of various photometric quantities, such as luminous flux, illumination, and luminous intensity, were also adopted.

Reports dealing with nomenclature and symbols were presented by a sub-committee of the British National Illumination Committee, by the Illuminating Engineering Society in the United States, and by Prof. A. Blondel, some differences in procedure being evident. These matters will doubtless be dealt with by the international technical committee referred to above. A paper by Mr. E. C. Crittenden referred to the growing recognition of the desirability of a primary standard based on the luminous radiation from a surface under specified conditions, in preference to the construction of certain types of lamps. Recent researches on the light yielded by a black body at a prescribed temperature have led to promising results; for example, it appears that such a body at 2077° K. emits 70·2 candles per sq. cm. Confirmatory researches are, however, needed. Papers by Mr. L. Gaster, Mr. L. B. Marks, and others dealt with industrial lighting, special reference being made to the question of legislation, as exemplified in the codes of some American States. While there was a recognition that the time is ripe for statutory provisions requiring adequate and suitable lighting in general terms, it was felt that it would be premature to attempt to frame a detailed series of requirements as a basis for legal procedure. Ultimately, however, an "international code" of factory lighting may be realised. Other papers dealt with motor-headlight regulations, which, like the preceding subject, was referred to a committee; and there were a number of contributions summarising recent progress in heterochromatic and physical photometry. Of special interest was a paper by Dr. E. P. Hyde, giving results for the mechanical equivalent of light, the most recent determination being in the neighbourhood of 0·00150 watts per lumen.

It was provisionally arranged that the next meeting should take place in the United States in 1924.

University and Educational Intelligence.

BIRMINGHAM.—On the recommendation of the Senate, a University Research Committee has been appointed. This committee consists of fifteen members, viz. the Vice-Chancellor, the Principal, and five other members elected by the Council of the University, together with eight members of the Senate, elected on the nomination of the faculties as follows: three from the Faculty of Science, two each from the Faculties of Arts and Medicine, and one from the Faculty of Commerce. These members are appointed in the first place for two years, and are eligible for reappointment at the end of that period. The object of the committee is "to facilitate by all means in its power the prosecution and publication of original research in all branches of knowledge." The members appointed by the Council are Sir Richard Threlfall, Messrs. T. S. Walker, W. Waters Butler, Hugh Morton, and William Tangye; and the Faculty of Science is represented by Profs. F. W. Burstall, F. W. Gamble, and S. W. J. Smith. The Registrar is to act as secretary.

The Durham Coal Owners' Association has announced that the Northumberland Coal Owners' Association is prepared to recommend its members to join with those of the former association in contributing a total sum of 500*l.* per annum for a period not exceeding three years to the Mining Research Laboratory of the University of Birmingham, unless the fund constituted under the Mining Industry Act should be drawn upon for this purpose.

Mr. L. Eastham has been appointed lecturer in zoology, and Miss Laura M. Ligertwood lecturer in physiology (to succeed Dr. Frost).

CAMBRIDGE.—Messrs. A. B. Appleton, Downing College, D. G. Reid, Trinity College, A. Hopkinson, Emmanuel College, and V. C. Pennell, Pembroke College, have been reappointed demonstrators in anatomy. Mr. E. W. Hulme has been elected to the Sandars readership in bibliography and palæography for the year 1921.

The address of the retiring Vice-Chancellor, Dr. P. Giles, master of Emmanuel College, refers to many interesting points. On extensions and new buildings more than 130,000*l.* was spent in the last year. The greater portion of the money was for chemistry, biochemistry, parasitology and the low temperature station, and was provided from special endowments. But more money is still required to meet the expenses incurred in the new engineering school. It may be of interest to other institutions to note that the University has now to provide more than 10,000*l.* in local rates for the present year. Fear was expressed by the Vice-Chancellor that increased cost of maintenance might compel the University to make a small charge for admission to the Fitzwilliam Museum and the Botanic Garden. Reference was made to the increase in the number of research students, and to a beginning made in the exchange of teachers between universities. The new Vice-Chancellor is Dr. E. C. Pearce, master of Corpus Christi College.

The vote on the admission of women to the University will take place on October 20. This is presum-

ably the last opportunity that the University will have of settling the problem for itself.

LONDON.—The following are some of the public lectures to be given at University College during the Michaelmas term:—Three lectures on "Babylonian Magic," by Dr. T. G. Pinches; a course of lectures on "Einstein's Theory of Relativity," by Dr. G. B. Jeffery; one lecture on "The Philosophical Aspects of the Theory of Relativity," by Prof. G. Dawes Hicks; eight on "Nutrition," by Dr. J. C. Drummond; three on "Nature in the 'Divina Comedia'"; one on "Recent Researches in Photo-Elasticity," by Prof. E. G. Coker; and a course of lectures on "The Evolution of Man," by Prof. G. Elliot Smith. A full list of the lectures may be obtained by sending a stamped addressed envelope to the Secretary, University College, London, W.C.1.

Eleven separate courses of lectures on the history of science will be delivered at University College during the session 1921–22. There will be a course on "The General History and Development of Science," by Dr. A. Wolf, and one on "The Beginnings of Science," by Prof. Elliot Smith. In addition, there will be courses on the history of particular departments of science, namely, Astronomy, Prof. Filon; Physics, Sir William Bragg and Mr. Orson Wood; Chemistry, Prof. Donnan; The Alchemical Period, Prof. Collie; From Mayow and Boyle to Dalton and Avogadro, and the Development of the Molecular Theory, Dr. Irvine Masson; The Development of Organic Chemistry in the Nineteenth Century, Dr. O. L. Brady; The Development of Physical Chemistry in the Nineteenth Century, Mr. W. E. Garner; and The Biological and Medical Sciences, Dr. C. Singer.

A course of public lectures on "Psychology and Psychotherapy" will be delivered at King's College, Strand, W.C., on Tuesdays at 5.30 p.m., beginning October 18, by Dr. William Brown, Wilde reader in mental philosophy in the University of Oxford. Admission is free without ticket.

FOUR lectures by Dr. F. W. Aston on atomic weights and isotopes will be delivered at 5.45 p.m. on successive Wednesdays, commencing October 12, at Battersea Polytechnic, S.W.11. This is the first occasion on which a course of lectures dealing with this topic has been given in London.

A LECTURE on "The Geology of Petroleum" will be delivered at the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C., by Mr. E. H. Cuningham Craig on Monday, October 10, at 7 p.m. The lecture, at which Sir Frederick Black will preside, will form an introduction to the course of petroleum technology which the institute is offering this year for the first time.

THE Universities' Library for Central Europe has now been in existence for a little more than a year, and a report has been issued giving an account of its activities up to March 31 last. Up to that date more than 2000 works had been despatched to various centres in Europe for distribution to universities, and, in addition, large numbers of scientific reviews and periodicals and the journals and transactions of learned societies had been forwarded. Something substantial has, therefore, been done to replenish the stocks of English literature in the universities and libraries of Central Europe. The library has also been able, as a result of correspondence with the Conjoint Board of Scientific Societies, to put many of the Continental universities in touch again with British scientific societies with the view of exchanging publications, and by an appeal to a number of scientific journals reduced subscription rates have in many cases been secured. Although much valuable assistance has been rendered in this way, the response made to the appeal for books, publications, and subscriptions has not been sufficient to enable the library to cope with the very real dearth of scientific works from which European universities are suffering. Further donations of books and money are therefore solicited, and gifts should be forwarded to the hon. secretary, Mr. B. M. Headicar, London School of Economics, Clare Market, London, W.C.2.

THE calendar of the North of Scotland College of Agriculture for 1921–22 may be divided conveniently into two portions, one dealing with the facilities for instruction which will be available in the coming session, and the other with the extra-mural work carried out by the college. The courses of study vary in length. Three-year courses are arranged for students preparing for the B.Sc. in agriculture and in forestry, as well as for the National Diplomas in Agriculture and Dairying awarded jointly by the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland; two-year courses lead to diplomas in agriculture and forestry awarded by the University of Aberdeen; and there is a special one-year course in preparation for the college Planter's Certificate. Two courses of evening lectures on horticulture and manures respectively have also been arranged. Important research work is being carried out in conjunction with Aberdeen University at the Rowett Institute for Research in Animal Nutrition. Extra-mural work of the college staff affects the whole of the North of Scotland and the adjacent islands. Advice on farm management, plant diseases, insect pests, and seed-testing is given, and under the direction of county organisers lectures and instruction in agriculture, horticulture, dairying, poultry keeping, etc., are given at recognised centres.

THE Cleveland Technical Institute, Middlesbrough, was formally declared open by Sir Charles A. Parsons on September 22. The institute, which is the outcome of joint action by the Cleveland Institution of Engineers and the North-East Coast Institution of Engineers and Shipbuilders, has been established with the object of providing facilities for engineers, shipbuilders and metallurgical chemists desirous of becoming thoroughly conversant with new developments in their own and cognate subjects. Membership will be limited to members of the societies which have founded the institute, together with the members of local technical societies, and the government will be in the hands of a council constituted from representatives of the various participating societies and donors under the chairmanship of Dr. J. E. Stead. It is hoped that the institute may encourage the continued technical education of employées in industrial works in the Tees-side districts, and to further this object lectures to workmen on subjects relating to local industries will be arranged; improvements in processes and designs will be investigated, and also a bulletin of abstracts from current scientific papers will be published monthly. In declaring the institute open, Sir Charles Parsons emphasised the importance of technological training for maintaining our industries, and congratulated Dr. Stead and the council on organising successfully an institution which would be open to members of all the technical societies, engineering, chemical, and metallurgical, established in the neighbourhood. This scheme, though it has been advocated widely, has never before been put into effect in this country, but where it has been adopted the results have been eminently satisfactory.

Calendar of Scientific Pioneers.

October 6, 1825. Bernard Germain Etienne de la Ville, Comte de Lacépède, died.—The disciple and friend of Buffon, Lacépède, after the Revolution, was appointed to a chair of zoology in the Jardin des Plantes, and published various works on natural history.

October 6, 1880. Benjamin Peirce died.—A leader in the American world of science, Peirce was professor of astronomy and mathematics at Harvard, and for some time superintendent of the U.S. Coast Survey. He wrote many treatises, and was a founder of the American Academy of Sciences.

October 6, 1894. Nathanael Pringsheim died.—The founder in 1858 of the Jahrbuch für Wissenschaftliche Botanik, and in 1882 of the German Botanical Society, Pringsheim contributed much to the study of sex in plants, of algæ, and of alternations of generations.

October 6, 1902. John Hall Gladstone died.—Following in the footsteps of Graham, Gladstone devoted himself mainly to physical chemistry, and especially studied the relation of the elements and compounds to light. Of independent means, he gave much time to educational and social matters. He was the first president of the Physical Society.

October 6, 1911. John Hughlings Jackson died.—Physician to the London Hospital and the Hospital for Epileptics, Jackson was one of the first in England to use the ophthalmoscope, and was distinguished by his work on the nervous system and epilepsy.

October 7, 1847. Alexandre Brongniart died.—A famous mineralogist and the associate of Cuvier, Brongniart, after serving in the army, became director of the Sèvres porcelain factory, and in 1822 succeeded Haüy at the École des Mines.

October 8, 1647. Christian Severinus Longomontanus died.—An assistant to Tycho Brahe at Hven, Longomontanus, or Longberg, accompanied Tycho to Bavaria, and from 1605 onwards was professor of mathematics at Copenhagen. His "Astronomica Danica," 1622, is an exposition of the Tychonic system of the world.

October 9, 1869. Otto Linné Erdmann died.—For nearly forty years professor of technical chemistry at Leipzig, Erdmann made valuable researches on nickel and on indigo and other dyes, and with Marchand made determinations of atomic weight.

October 10, 1679. John Mayow was buried.—Remembered for his advanced views on combustion and respiration, Mayow, who was a physician, died in London in September, 1679, and was buried on October 10 in St. Paul's, Covent Garden. It has been said that his premature death retarded the advance of modern chemistry by a century.

October 10, 1708. David Gregory died.—Nephew to James Gregory, the inventor of the reflecting telescope, David Gregory owed his fame to his advocacy of the Newtonian philosophy, which he was the first publicly to teach. From 1691 he was Savilian professor of astronomy at Oxford.

October 11, 1709. Ehrenfried Walter Graf von Tschirnhausen died.—A mathematician, Tschirnhausen was the founder of catacaustics, and was known as the maker of large burning glasses.

October 11, 1889. James Prescott Joule died.—The favourite pupil of Dalton, and one of the most intimate friends of Kelvin, with whom he collaborated, Joule is universally known for his determination of the mechanical equivalent of heat, and for his share in establishing the law of the conservation of energy. His epoch-making papers were read in 1843, 1845, 1847, and 1849. The Copley medal was awarded to him in 1870. E. C. S.

Societies and Academies.

BIRMINGHAM.

Institute of Metals.—Annual autumn meeting, September 21.—Prof. A. A. **Read** and R. H. **Greaves**: The properties of some nickel-aluminium-copper alloys. In some of the copper-rich nickel-aluminium-copper alloys the α-solution will retain more nickel and aluminium at 900° C. than at the ordinary temperature. These alloys, while relatively soft on quenching from 900° C., are hardened by slow cooling or by reheating to lower temperatures. This change is the result of the appearance of a new constituent, probably a nickel-aluminium-copper solid solution, the separation of which is accompanied by changes in density and electrical conductivity, in addition to its effect on tensile, hardness, notched bar, and other tests. The separation of this special constituent takes place slowly, so that chill-cast alloys and hot-rolled rods of small section consist almost wholly of the α-constituent. On annealing the cold-rolled alloys softening proceeds slowly up to 500° C., when precipitation of the nickel-aluminium-rich constituent begins to take place. If the separation is sufficient, this may give an alloy of high elastic limit and tensile strength and good elongation. The hardest product is obtained by reheating the quenched alloy for some time at 600–700° C. Alloys so treated generally give better properties than those obtained by uniform rates of slow cooling, and show considerable endurance under alternating stresses above their true fatigue limit.—R. T. **Rolfe**: The effect of increasing proportions of lead upon the properties of Admiralty gunmetal, with an appendix dealing with the effect of lead on gunmetal containing copper 85 per cent., tin 5 per cent., and zinc 10 per cent. Synthetic alloys containing increasing proportions of lead up to 1·68 per cent. were examined. In sand-cast gunmetal lead gradually increases the strength, ductility, and softness of the alloy up to about 1·5 per cent. of lead, but above this proportion causes a decrease in all three. It does not affect the soundness. In chill-cast gunmetal the effect on the hardness parallels that of the sand-cast metal, with a change-point at about 1·5 per cent. of lead, but associated with a minimum rather than a maximum strength figure. It does not affect the soundness. The influence of lead on liquation, machinability, corrosion, and behaviour for bearing purposes is discussed, and it is suggested that in sand-cast gunmetal the proportion of lead permitted by the Admiralty specification might with advantage be increased from 0·5 to 1 per cent.—R. **Genders**: The casting of brass ingots. The failure of hollow-drawn articles made from brass rod has generally been found to be due to the presence of non-metallic inclusions which originated in the cast ingot. The methods used in casting ingots of brass vary, much consideration being given to the saving of rolling. When a hollow article subject to expanding stresses is to be made, the avoidance of inclusions of foreign matter is vital, and the form of ingot requires modification. The ingots made were 3 in. square and 30 in. in length, as compared with the ingots 6–7 ft. in length and 1½ in. square section in common use. A hot sinking head or "dozzle" was introduced, and molten brass is poured through the "dozzle." No pipe is formed in the ingot proper, and additions of metal may be made at any time to the metal in the "dozzle" without risk of introducing defects into the ingot, any dross rising to the top of the still fluid head. The moulds were tapered, the top being enlarged by increasing amounts in successive experiments, and ingots were cast at the usual foundry speed.—T. G. **Bamford**: The density

of the zinc-copper alloys. Experiments were conducted with alloys made from pure metals and cast in sand- and chill-moulds respectively. There is a contraction in volume due to alloying with mixtures containing more than 25 per cent. of copper, and the density of the sand-cast or slowly cooled alloys is generally less than that of the chill castings; at points where the liquidus and solidus coincide on the constitutional diagram, chill castings and sand castings give the same values. The expansion recorded by Turner and Murray with alloys containing less than 30 per cent. of copper is confirmed, and is shown to be connected with a new form of porosity different from ordinary unsoundness.—Dr. F. **Johnson**: Experiments in the working and annealing of copper. Part 1: Critical ranges of deformation probably result from stages of abnormal plasticity during rolling of the metal. It is suggested that during these stages the metal actually loses some of the increase of hardness conferred in earlier "passes." A decrease of volume up to 85 per cent. occurs; the increase of volume which then sets in may correspond to the inception of permanent disability which cannot be eradicated by annealing. Part 2: At 200° C. for one hour softening occurs in all strips rolled beyond 40 per cent. reduction. Test-pieces from the axes of the strips undergo softening to a greater extent than edge-specimens from the same series when annealed under the same conditions, thus indicating a greater intensity of strain at the centre than at the edges. High-temperature annealing at 750° C. shows that at 87 per cent. reduction a rapid decrease in strength sets in. Part 3: Low-temperature annealing of cold-drawn copper rods of varying compositions. "Tough-pitch" arsenical rods retain their strength practically unimpaired up to 300° C., whereas "tough-pitch" electrolytic copper undergoes considerable loss of strength. The presence of silver in arsenical rods raises slightly the annealing temperature. The substitution of iron for oxygen in arsenical copper retards the rate of softening.—W. E. **Alkins** and W. **Cartwright**: The effect of progressive cold-drawing upon some of the physical properties of low-tin bronze. The tin content varied from about 0·7 to about 1·0 per cent. in the three samples of bronze studied. The most important and rapid changes in properties occur after a reduction of 85 per cent. of the original area, *i.e.* over the range where practical difficulties are met with during drawing. The extent of the variation in tensile strength, specific volume, and scleroscope hardness is very similar to that previously found in the case of copper.

September 22.—R. **Genders**: The extrusion defect. Experiments have been carried out with the object of devising a method of extrusion which would avoid the formation of the defect known as "piping," which is commonly found in some centrally extruded rod made from brass and other non-ferrous alloys by the usual hot-extrusion process. The defect is tubular in the interior of the rod, and generally exists in the last portion extruded. When a defective rod is broken across, the core frequently breaks at a different point from the outer ring. The defect consists of foreign matter, oxide and dezincified brass, which constituted the skin of the original billet. Billets extruded to various stages and sectioned axially show the presence of the defect in the shape of a funnel. The defect can be largely overcome by the use of a ram smaller in diameter than the billet, which causes the outer layer of the billet to remain in the receiver as a thin cylinder, but the method would probably be too wasteful on a large scale. By inverting the process so that the die is pushed through the billet the mode of flow is altered. There is no relative movement between the billet and receiver, and flow is confined to the region of the die. The power required is less than with the method at present in use. The method is in use in many places for the production of tubes and rod from soft metals.—F. S. **Tritton**: The use of the scleroscope on light specimens of metals. Errors were detected when using the ordinary methods of support, and to reduce them pitch and glucose were selected. The use of pitch requires a special clamp, a new type of which is described. A solution of glucose considerably stiffer than treacle gave good results, the specimens being attached by means of the glucose to a hard steel base. The hardness of specimens having both flat and curved surfaces can be tested provided that a recessed support be made to fit the specimens.—D. H. **Ingall**: The relation between mechanical properties and microstructure in pure rolled zinc. The material as rolled, and also when annealed, at 100° and 150° C., is ductile "with" and brittle "across" the direction of rolling, with reduction from 77 to about 87 per cent.; it is ductile in all directions with 96 per cent. reduction by rolling, where the strength has risen from about 6 to about 13 tons per sq. in. An equi-axed structure exists in all cases. Annealing for thirty minutes at 200° C. renders the material completely brittle and weak, due to a crystallisation.—Dr. D. **Hanson** and Marie L. V. **Gayler**: The constitution and age-hardening of the alloys of aluminium with magnesium and silicon. The ternary system aluminium, magnesium, and silicon, containing up to 35 per cent. of magnesium and 11 per cent. of silicon, has been investigated. Thermal curves and microscopic examination prove that magnesium and silicon form a chemical compound having the formula Mg_2Si, which with aluminium forms a eutectiferous binary system, having an eutectic containing 13 per cent. of Mg_2Si, and melting at 590° C. The aluminium-Mg_2Si-silicon system possesses a ternary eutectic that melts at 550° C.; the ternary eutectic of the aluminium-Mg_2Si-magnesium system melts at 450° C. The solubility of Mg_2Si in solid aluminium is 1·6 per cent. of Mg_2Si at 580° C. and about 0·5 per cent. at 30° C. Excess of silicon has little effect, but magnesium reduces the solubility at high temperatures. The difference in the solubility of Mg_2Si at high and low temperatures is the cause of the age-hardening property of these alloys, which in a series of alloys containing increasing amounts of Mg_2Si rises progressively until the limit of the solubility of Mg_2Si in aluminium at the quenching temperature is reached, beyond which the total increase in hardness remains constant. The increase in hardness is roughly proportional to the amount of Mg_2Si retained in solution by quenching.—F. **Adcock**: The electrolytic etching of metals. A solution of citric acid as an electrolyte in the etching bath gave good results with cupro-nickel (80 : 20), silver, nickel-silver, and some other metals. Certain specimens of silver showed on etching a cell-structure or network which was smaller than, and in some cases independent of, the existing crystal grains. Another electrolyte made by dissolving molybdic acid in excess of ammonia solution gave similar results, and revealed a subsidiary cell-formation or network in the β-regions of a $\beta+\gamma$ brass containing 6 per cent. of aluminium. By using hydrofluoric acid, chromic acid, and bromine water, both the cores and the crystal-grain boundaries of cast cupro-nickel were disclosed simultaneously.—S. **Beckinsale**: The magnesium alloy "electron." Samples of the new high magnesium alloy "electron" contained about 95 per cent. of magnesium, 4·5 per cent. of zinc, and 0·5 per cent. of copper. The alloys machined well,

and compared very favourably with aluminium alloys in tensile properties (allowance being made for the much lower specific gravity), but they were not so ductile in compression.

PARIS.

Academy of Sciences, September 19.—M. Georges Lemoine in the chair.—The President announced the death of Alfred Grandidier, member of the section of Geography and Navigation.—J. **Kampé de Fériet**: Some properties of hypergeometrical functions of higher order with two variables.—MM. **Barbillion** and M. **Dugit**: A simple apparatus for obtaining the deviation of the edge of an aeroplane due to the effect of the wind.—M. **d'Azumbuja**: A method for the synchronisation of clock mechanism and of pendulums employed in astronomy. The clockwork mechanism generally used in observatories for controlling the motion of telescopes or mirrors do not possess the accuracy of astronomical clocks, and when used for long photographic exposures frequent rectifications by the observer are necessary. In the apparatus proposed by the author, which has been set up at Meudon, a weight-driven motor is controlled electrically by a pendulum. A diagram of the arrangement is given; it has been in use at Meudon for more than a year, and has proved satisfactory.—A. **Kozlowski**: The origin of the oleoleucites in the liverworts carrying leaves. The examination of living specimens of *Lophocolea heterophylla, L. bidentata, Lepidozia reptans,* and *Mastygobryum trilobatum* leads to the conclusion that Pfeffer's hypothesis on the formation of oleoleucites by the agglomeration of droplets is justified, in spite of the contrary opinions of Wakker, Raciborski, and Garjeanne.—M. **Romieu**: Morphology of the spermatozoid of Chætopterus.—M. **Bridel**: the action of emulsin from almonds on lactose in 85 per cent. ethyl alcohol. The reaction is a complex one: galactose and β-ethylgalactoside were isolated, the former in crystalline form.

SYDNEY.

Royal Society of New South Wales, August 3.—Mr. E. C. Andrews, president, in the chair.—R. H. **Cambage**: Acacia seedlings. A seed of *Acacia melanoxylon* from Jenolan Caves had germinated after having been immersed in sea-water for four years and one month. The rapid germination of *A. Oswaldi*, which grows in the dry interior, is noted. This character may have been developed through the habit of germination after thunderstorms, when the young plant has to establish itself before the succeeding dry weather overtakes it.—G. D. **Osborne**: A preliminary examination of the late Palæozoic folding in the Hunter River District, New South Wales. By the aid of a diagram, giving the elemental features of the diastrophism, it is shown that the earth's segment in the district has undergone a crustal shortening of 7·46 miles, the original width of 77·96 miles now being compressed into 70·50 miles. The depth of the earth block involved has been calculated, and the effects of the strike faulting, in relation to the determination of the vertical bulging resultant upon the thrusting, are discussed.—A. R. **Penfold**: Note on the position of the double linkage in piperitone. On oxidation with neutral potassium permanganate solution diosphenol in monoclinic needles of melting point 82° C. was obtained. This body possesses a well structure of which the double linkage is in the 1 position. Piperitone must therefore be Δ-1-menthone-3.—Dr. L. A. **Cotton**: Earth movements at Burrinjuck, as recorded by horizontal pendulum observations. Horizontal pendulums were installed to measure the movement of the rocks under the load of water impounded by the Burrinjuck Dam, and the relation between the movements of the pendulums and the temperature changes registered by a thermometer placed within the concrete dam, at a distance of 80 ft. from the surface, were investigated. The rock movements are seasonal in character, with a lag of several months, corresponding closely to the temperature lag. The actual movement is from five to ten seconds of arc, which is probably sufficient to cause considerable strain in the rock-masses involved.

Books Received.

The Rift Valleys and Geology of East Africa: An Account of the Origin and History of the Rift Valleys of East Africa and their Relation to the Contemporary Earth-Movements which Transformed the Geography of the World. By Prof. J. W. Gregory. Pp. 479. (London: Seeley, Service and Co., Ltd.) 32*s.* net.

Zoology for Medical Students. By Prof. J. Graham Kerr. Pp. x+485. (London: Macmillan and Co., Ltd.) 25*s.* net.

A Text-book of Qualitative Analysis of Inorganic Substances. By Dr. S. A. Kay. Pp. vii+80. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd.) 7*s.* 6*d.* net.

The International Forestry Bibliography, including Allied Subjects. By Dr. A. H. Unwin. Pp. 48. (Critchmere, Haslemere: Forest Lover's Library.) 2*s.* 6*d.* net.

Wightman's Secondary Schools Mathematical Tables. Edited by F. Sandon. Pp. 96. (London: Wightman and Co., Ltd.) 6*d.*

The Depths of the Soul: Psycho-Analytical Studies. By Dr. William Stekel. Authorised translation by Dr. S. A. Tannenbaum. Pp. v+216. (London: Kegan Paul and Co., Ltd.) 6*s.* 6*d.* net.

An Introduction to Biophysics. By Dr. D. Burns. Pp. xiii+435. (London: J. and A. Churchill.) 21*s.* net.

Handbuch der Gesamten Augenheilkunde. Begründet von A. Graefe und Th. Saemisch. Fortgeführt von C. Hess. Herausgegeben von Th. Axenfeld und A. Elschnig. Dritte, neubearbeitete auflage. Die Brille als Optisches Instrument. Von Prof. Dr. M. von Rohr. Dritte auflage. Pp. xiv+254. (Berlin: J. Springer.) In Germany, 66 marks; in England, 132 marks.

The Chemistry of Colloids and some Technical Applications. By Dr. W. W. Taylor. Second edition. Pp. viii+332. (London: E. Arnold and Co.) 10*s.* 6*d.* net.

An Introduction to Projective Geometry. By Prof. L. N. G. Filon. Third edition. Pp. viii+253. (London: E. Arnold and Co.) 7*s.* 6*d.*

Forensic Chemistry. By A. Lucas. Pp. viii+268. (London: E. Arnold and Co.) 15*s.* net.

Organic Evolution: Outstanding Difficulties and Possible Explanations. By Major Leonard Darwin. Pp. viii+47. (Cambridge: At the University Press). 4*s.* net.

On some Antiquities in the Neighbourhood of Dunecht House, Aberdeenshire. By the Right Rev. Dr. G. F. Browne. Pp. xiv+170+63 plates. (Cambridge: At the University Press.) 63*s.* net.

A First Book of General Science: An Introduction to the Scientific Study of Animal and Plant Life. By A. T. Simmons and A. J. V. Gale. (First Books of Science series.) Pp. viii+145. (London: Macmillan and Co., Ltd.) 2*s.* 6*d.*

The Institution of Mechanical Engineers. Eleventh Report to the Alloys Research Committee. On Some Alloys of Aluminium (Light Alloys). By Dr. W.

Rosenhain, S. L. Archbutt and Dr. D. Hanson. Pp. ii+256+24 plates. (London: Institution of Mechanical Engineers.) 2*l*. 2*s*.

A Synopsis of the Accipitres (Diurnal Birds of Prey). By H. Kirke Swann. Part 1 (Vultur to Accipeter). Second edition, revised and corrected throughout. Pp. 63. (London: Wheldon and Wesley, Ltd.) 6*s*.

Fishing from the Earliest Times. By W. Radcliffe. Pp. xviii+478. (London: J. Murray.) 28*s*. net.

The Diagnosing of Troubles in Electrical Machines. By Prof. M. Walker. (Electrical Engineering Series.) Pp. xii+450. (London: Longmans, Green and Co.) 32*s*. net.

Nature Lessons with Plants. By E. Kay Robinson. (Nature Lovers' Library.) Pp. 136. (London: Holden and Hardingham, Ltd.) 1*s*. net.

Nature Lessons with Animals. By E. Kay Robinson. (Nature Lovers' Library.) Pp. 144. (London: Holden and Hardingham, Ltd.) 1*s*. net.

Grasses and Rushes. By Dr. S. C. Johnson. (Nature Lovers' Library.) Pp. 143. (London: Holden and Hardingham, Ltd.) 1*s*. net.

Everybody's Book of Astronomy. By E. G. Fenner. (Nature Lovers' Library.) Pp. 144. (London: Holden and Hardingham, Ltd.) 1*s*. net.

Handbook of Chemistry and Physics: A Ready-Reference Pocket Book of Chemical and Physical Data. By Prof. C. D. Hodgman and others. Eighth edition. Pp. 711. (London: Chapman and Hall, Ltd.) 24*s*. net.

A History of the Cambridge University Press, 1521–1921. By S. G. Roberts. Pp. xv+190. (Cambridge: At the University Press.) 17*s*. 6*d*. net.

Sur l'Origine dell'Uomo: Nuove Teorie e Documenti. By Prof. V. Giuffrida-Ruggeri. Pp. xiii+269. (Bologna: N. Zanichelli.) L. 24.

Diary of Societies.

THURSDAY, OCTOBER 6.

CERAMIC SOCIETY (Refractory Materials Section) (at Institution of Mechanical Engineers), at 10.30 a.m.—H. Dewey: Refractory Materials of the London Basin.—J. H. Marlow: The Marlow Gas-fired Tunnel Oven.—P. J. Woolf: A New Type of Tunnel Kiln, Oil-fired, with many Novel Features.—Dr. A. Granger: Aluminothermic Corundum as Refractory Materials.—Prof. J. W. Cobb and H. S. Houldsworth: The Reversible Thermal Expansion of Silica.—Discussion on Gas-firing.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Air Commodore H. R. H. Brooke-Popham: Some Notes on Aeroplanes in Tropical Countries.

CHEMICAL SOCIETY, at 8.—S. J. Lewis and F. M. Wood: A New Adjustable Thermostat for all Temperatures between 0° and 100°.—A. F. Dufton: The Separation of Miscible Liquids by Distillation. Laboratory Still-heads.—A. F. Dufton: The Separation of Miscible Liquids by Distillation. A Continuous Laboratory Still.—P. K. Dutt, H. R. Whitehead, and A. Wormall: The Action of Diazo-salts on Aromatic Sulphonamides. Part I.—A. B. Manning: Neutral Salt Action on the Hydrolysis of Ethyl Formate.—A. Shimomura and J. B. Cohen: Synthetic Optical Activity.—T. A. Henry and H. Paget: Chenopodium Oil.—C. K. Ingold and E. A. Perren: Experiments on the Synthesis of the Polyacetic Acids of Methane. An Addendum to Parts I. and III.—C. K. Ingold and W. J. Powell: Experiments on the Synthesis of the Polyacetic Acids of Methane. Part IV. The Preparation of β-Carboxymethanetricacetic Acid.—The Late H. R. Le Sueur and C. C. Wood: The Mechanism of the Action of Fused Alkalis. Part II. Action of Fused Potassium Hydroxide on Phenylglyceric Acid.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. Barris and Dr. McCurrich: Case of Hæmatoma of the Vulva following Labour.—Dr. R. A. Hendry: Case of Prolonged Gestation.—Dr. F. A. Nyulasy: Polypoid Decidual Endometritis.

FRIDAY, OCTOBER 7.

CERAMIC SOCIETY (Refractory Materials Section) (at Institution of Mechanical Engineers), at 10 a.m.—General Meeting.

JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—Dr. F. W. Edridge-Green: Colour Vision and Colour Blindness.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at West London Hospital), at 8.30.—Sir G. Lenthal Cheatle: A Study of Breast Cancer in Relation to the Cancer Problem (Presidential Address).

MONDAY, OCTOBER 10.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.30.—Sir John Goodwin: The Aftermath of War, with Reference to the Medical Service of the Army (Presidential Address).

ARISTOTELIAN SOCIETY (at 21 Gower Street), at 8.—Dr. F. C. S. Schiller: Novelty (Presidential Address).

TUESDAY, OCTOBER 11.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—A. Earland: Deep Sea Deposits.

WEDNESDAY, OCTOBER 12.

ROYAL SANITARY INSTITUTE, at 4.—Discussion on Plumbing and Sanitation on Board Ship.

NEWCOMEN SOCIETY (at Institute of Marine Engineers, 85 Minories), at 5.—G. F. Zimmer: History of Continuous Conveying Devices.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 8.—G. Watson: Industrial Standardisation (Presidential Address).

THURSDAY, OCTOBER 13.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. W. Kimmins: Springs of Laughter.

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (In Lecture Room, Hotel Cecil), at 8.—Dr. Marie Stopes: Anecdotes of the Past, Present, and Future of Birth Control (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—P. Sargent: Presidential Address.

FRIDAY, OCTOBER 14.

ASSOCIATION OF ECONOMIC BIOLOGISTS (In Botanical Lecture Theatre, Imperial College of Science), at 2.30.—Dr. W. Brown and Others: Discussion on the Physiology of the Infection Process.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—J. H. Parsons: The Fourth Cranial Nerve.—E. Clarke: Milestones in Refraction Work.

SATURDAY, OCTOBER 15.

PHYSIOLOGICAL SOCIETY (at Guy's Hospital).

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